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MAGAZINE

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MAGAZINE**

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The Smallest DOS  
Computer Yet**



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**The Check Is in the  
E-mail: CheckFree  
Ends Bill-Paying  
Hassles (Mostly)**

**FREE UTILITY**

**MCI Mail Manager:  
1STCLASS Takes On  
Lotus Express**

VOLUME 8 NUMBER 19

THE INDEPENDENT GUIDE TO IBM-STANDARD PERSONAL COMPUTING

NOVEMBER 14, 1989

**Better Than  
a LaserJet  
—from IBM**

**Finally,  
the \$1,000  
Laser!**

**PC LABS TESTS 109**

# **PRINTERS**

**NEW**

**Laser Printers  
Color Page Printers  
Dot Matrix Printers  
Color Dot Matrix Printers  
Portable Printers**

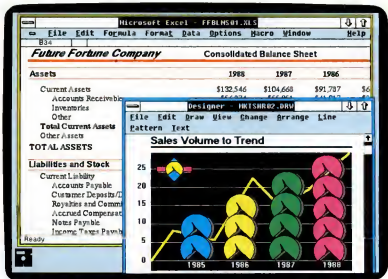
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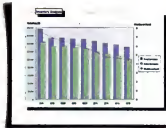
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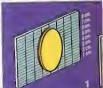
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Future Fortune Company



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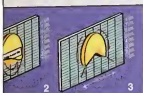
#### Old sayings may cost Future Fortune

It has been roughly 60 years since FFC last created new fortunes. But in light of the new logo and the whole new look brought to the company in the past year, the board of directors has unanimously voted to replace the old fortunes. President Jim Dearing explained, "As we exit the 1980's, people no longer believe in the same old lines, it's time to change."

## Fortune Teller

1989

### Cookie Standards, roiling in the dough



...reads, the Fortune is  
...lower third of the  
...and slightly to the  
...bottom is folded, the  
...fortune should be  
...placement is all-  
...factors the consumer to  
...a cookie without tear-  
...it.

The last, and the most intricate,  
step in Fortune Teller Cookie mak-  
ing is when our triple diagonal is  
placed on the cookie. As the server  
indicates, it is important to push down  
on both sides of the cookie so the  
diagonal is pushed in from the  
bottom.

### Fortunes for the month of August

Find a reliable car pair  
Important call on your car phone.  
Surgery life spans as well as sorbides  
will never return from maternity leave  
sit is a thing of the past. Invest in a car soon  
rest in real estate will only lead to frustration.  
wager as well your accountant.  
wishes second nobody remembers.

...do amazing things—like this—simply.



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# Inside

The annual *PC Magazine* printer roundup is our biggest issue of the year. With reviews of 109 printers, this sixth annual printer blockbuster is the largest in five years.

What does it take to make this project fly? Teamwork, and lots of it. For six months, more than 50 people worked together like a well-oiled machine.

Grounded in the traditions of past issues, this year's team used the text speed test in use since 1984. Therefore, you can compare the results for the nearly 600 printers we've reviewed over the last six years. The Index, put together by editorial assistant Wendy Murch and editorial secretary Jean Risolo, lists prices and text speed results for the 312 printers that are still available.

PC Labs project leader Bill O'Brien—with help from contributing editor Alfred Poor—added new graphics and color output tests. There are new product categories, like color page printers, portable printers, and color dot matrix printers.

To find all these printers, editorial assistant Ann Sherman plowed through mounds of material gathered by researcher Tom Giebel, then contacted the 46 vendors that sell this year's crop.

In May, truckloads of printers arrived at our door. Soon inventory control coordinators Peter Bastide and Eric Thomas had their hands—and their PC Labs inventory room—filled with print-



ers. They tracked the printers in our database, measured the machines, and set them up for testing.

In June, PC Labs was busting out all over with 24 reviewers; PC Labs manager Bruce Freeman and inventory control manager John R. Delaney made the testing run like clockwork. Printer project veterans Bruce Brown, Alfred Poor, and M. David Stone reviewed the bulk of the printers and helped guide a slew of newer reviewers. Executive editor

John Dickinson, who directed the first *PC Magazine* printer project, flew in from the West Coast to lend his expertise.

As testing ended in July and August, mountains of output and test results were passed along to lab assistant Lisa Barr, who with Ann Sherman organized the

data for both the Guides to Printers and the Fonts & Features tables.

Throughout August, our editorial offices overflowed with reviews, which staff editor Stephanie K. Losee edited through many late nights. As we began to wind down in the labs and editorial offices, other departments began to gear up. Managing editor Diane D'Angelo and assistant editor M. Stephanie Ricks ushered the project through the copy edit, art, and production departments.

The result of this massive team effort is in your hands. If you're looking for a printer, you've come to the right place. —Mary Kathleen Flynn ■



Printer project behind-the-scenes staff: Eric Thomas, Wendy Murch, Peter Bastide, Lisa Barr, and Ann Sherman.

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8 ppm PostScript Laser Printers				
Type of Laser Printer	QMS-PS 810 <i>turbo</i>	QMS-PS 820 <i>turbo</i>	Apple LW II NTX	
Processing speed	20 MHz	20 MHz	16 MHz	
Time to print (in minutes)	Graphics (1 pg)	0.23	0.23	0.54
	Text (1 pg)	2.68	2.68	3.28
	Text + Graphics (1 pg)	0.90	0.90	1.36
List Price	\$5,995	\$6,995	\$6,995	

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January 31, 1989

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72 MB HD (28 ms 1:1)	\$2095	\$2495	\$2795
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Austin 386-20 Cash Price Matrix with 1MB of RAM			
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Austin 386/33 Config Price Matrix with 1989 AAAA			
Choose Hard Drive		Choose Monitor & Video Adapter Card	
		Microcomputer	VGA Color (640 x 480)
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72 MB HD (16 ms 1:1)	\$4795	VGA Color (640 x 480)	\$4995
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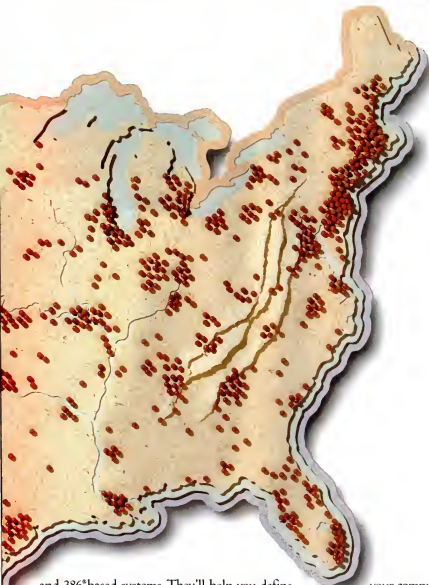
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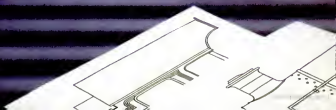
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# Letters

## DEEP-SIX THE 286?

I want to applaud *PC Magazine* for being so straightforward and honest with its readers concerning its recommendation on 286-based computers. In the recent feature sizing up the latest crop of 12-MHz 286 machines ("286s: No Frills, Few Thrills," *PC Magazine*, September 12, 1989), the Editor's Choice went to... "A 386SX Computer."

Many of us are struggling with decisions as to which PC we want to purchase, both at a personal and a professional level. It is refreshing to see that *PC Magazine* is not trying to straddle any fences with its very clear signal not to buy a 286 PC without looking both ways. Those of us who read *PC Magazine* saw this coming for some time now. However, when you need to convince senior management (either the Board of Directors or your wife) that you are not trying to "turn a Chevy into a Caddy," it helps to be able to refer to such clear and concise language from a respected source. Again, thanks for your candor!

Darrell Drago  
Cary, Illinois

Your 1989 editorial position seems to be that 386-processor based PCs are entry-level equipment. I agree, but for a reason you haven't mentioned: a 386 machine running interpretive BASIC will run a beginner's program just about as fast as it will run a compiled version of that program, and will therefore require a whole lot less programming experience to produce a useful program.

Although 20-MHz vs. 12-MHz may explain some of the difference, it cannot be said that a 286 machine will run interpreter BASIC as fast as the language really needs to run. And that's why a 386 ought to be an entry-level computer for any novice who wants to try his hand at some programming or for any employer who is paying for a programmer's time.

George Ross Fisher  
Philadelphia, Pennsylvania



C'mon guys! If the auto enthusiast magazines had the same attitude toward new technology that you do, there would be nothing smaller than V-8s in our cars, probably V-12s. Horsepower would be around 500 for economy cars.

Let's face it: the 286, 8086, and even the 8088 still have and will continue to have a huge share of the truly *personal* computer market. And as those of us with one of these PCs at home cannot just trade in the old model, we'll hold on to it for as long as it does the job or until prices on the 386 hot rods show a dramatic drop.

Just as we enjoy reading road tests of Porsches and Lambos, we also enjoy your "road tests" of the high-performance PCs. However, were *Autoweek* ever to suggest that the industry stop making four-cylinder engines because V-8s are faster and more powerful, we would surely consider the editors insane.

So keep the high-performance tests coming, but have some thoughts for those of us who have a Porsche (386) at work, and an old Chevy (8086) waiting at home. Jack Dorneden  
Kirtland AFB East, New Mexico

## LOW-COST E-MAIL

I read your review of the commercial e-mail services ("E-Mail, the Global Handshake," *PC Magazine*, August 1989) with a combination of interest and amusement, particularly regarding the costs of such services.

One potentially important (and inexpensive) source of e-mail and related services was completely overlooked in your article. I refer to public networks such as FidoNet, a system available in most urban areas and in many smaller towns in the hinterlands of the United States (many nodes also exist in Canada, Europe, Australia, and the Pacific Rim countries).

Most system operators, or SysOps, will work with users to allow them to send and receive messages and files between FidoNet nodes at cost-recovery prices. A good example of the cost/benefit ratio is this letter. If you had a FidoNet node at *PC Magazine*, I could have sent this message at about one-half the cost of the stamp on the envelope and it would have gotten to you overnight instead of 2 to 4 days later.

Anyone with a PC equipped with FidoNet-compatible software is eligible to become a "node" in the public network. Most of the necessary software is either shareware or public domain, and thus either inexpensive or free.

Interested parties are encouraged to search out a local BBS list and find a FidoNet node, or write to the following address for further information:

The International FidoNet Assoc.  
P.O. Box 41143  
St. Louis, MO 63141

FidoNet currently counts some 5,000 nodes in its distribution node list.

Justin Marquez  
Houston, Texas

## MYTH VS. REALITY

Tony Lime's letter, headed "Myth vs. Law" (Letters, *PC Magazine*, August 1989), chastises William F. Zachmann for allegedly perpetuating "an ongoing myth in the



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## Letters

computer industry; to wit, that computer languages are not subject to copyright laws." Unfortunately, the two examples that Mr. Lime presents as evidence of this claim are themselves "completely untrue."

Mr. Lime claims that "PL/1 and Ada are two examples of languages explicitly protected by copyrights." In fact, neither PL/1 nor Ada has such protection, and no such protection has ever been claimed. Mr. Lime appears to be confusing copyright protection with trademark protection. He also appears confused as to the legal differences among a language, the name of the language, and a document describing the language.

In the case of PL/1, IBM at one time laid claim to the names "PL/1" through "PL/99." IBM also claimed a copyright on every PL/1 manual available to the general public. However, the IBM publications lack any claim of trademark or copyright status, except for that of the publications themselves. Considering the power that the IBM legal staff has over such matters, it is inconceivable that these publications could have been issued without such notices unless the legal staff felt that no such claim would stand up in court.

In the case of Ada, the U.S. Government claims the name as a registered trademark and claims a copyright for the reference manual. However, as with PL/1, no claim has been made for any legal protection of the language itself.

Seymour J. Metz  
Annandale, Virginia

### MORTGAGE PAYMENTS FOR YOUR PC

Kudos to John Dvorak for his August article on computer recycling (John C. Dvorak, *PC Magazine*, August 1989). Perhaps the idea could be taken even one step further.

Unless an individual has a fair amount of disposable cash or wishes to partake of the various revolving credit plans available, the upgrade process is a pretty expensive proposition. In some cases, the new computer system may cost as much as a new car. Therefore, why not treat the purchase as such?

Retailers could allow a trade-in of the older computer and set up a payment plan for *x* amount of years for the new computer. After that time, the computer is yours. The advantage over the revolving

credit plan is obvious: you're no longer in the position of having to pay for a system (assuming the minimum payment each month) until your grandchildren are retired.

Christopher Bonk  
Raytown, Missouri

### YOU CAN'T TELL A BOARD BY ITS CHIP

We are obliged to comment on Alfred Poor's in-depth article on VGA adapters ("16-bit VGA Cards Stretch the Standard," *PC Magazine*, July 1989). Since Tseng Labs is a major player in the VGA market and a majority of the boards tested use our

As many of us with  
286, 8086, and 8088  
PCs at home cannot  
just trade in the old  
model, we'll hold on to  
the machine for as  
long as it does the job  
or until prices on the  
386 hot rods show  
a dramatic drop.

ET3000 series video graphics controller, we wish to clarify some possible misconceptions brought about by the article.

The performance and capabilities of adapters using Tseng Labs controller chips varies from one manufacturer to another. The performance of a graphics adapter is a result of the VLSI design, the BIOS design, and the software driver design. Tseng Labs isn't responsible for the board or BIOS designs of individual vendors using its components, so varying performance levels and capabilities should be more accurately attributed to this factor.

As indicated by the disparity in test results exhibited by the Peacock Plus EVGA and the Tecmar VGA/AD (both engineered around the Tseng Labs graphics controller), allusion to the performance of our controller chip cannot be made fairly, nor



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- Fast 800 KB/sec Data Transfer Rate
- 32K High Speed Hard Drive Cache
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CIRCLE 175 ON READER SERVICE CARD

## Letters

should it, based on the ultimate implementation of individual vendors' video boards.

Larry P. Lefkowitz  
Product Support  
Tseng Laboratories  
Newtown, Pennsylvania

I am confused by your article on VGA boards in the July 1989 issue. In his review of the ATI VGA Wonder, Ken Shelby states that ATI "produces its own VGA controller chip instead of using one from a supplier like Paradise or Tseng Labs." However, in the review of the SOTA VGA/16, Mr. Shelby states that "like the VGA Wonder, which also uses the Tseng Labs controller chip, the SOTA card failed the Vertical Blank Interrupt and the Pan and Scroll tests..."

Which statement is correct?  
Spencer J. Brody,  
Laconia, New Hampshire



The ATI VGA Wonder adapter, as reported in the July 1989 review, does indeed use a proprietary chip set and not the Tseng Labs controller chip. The statement to the contrary, in the SOTA VGA/16 review, is incorrect. *PC Magazine* regrets the error.



### DRIVER ED

Regarding Frank Bican's review of the Microvitec 1014/SP Auto-Sync monitor ("Multiscanning Monitors for VGA and Beyond," *PC Magazine*, May 16, 1989), I would like to point out that you guys (and my European friends) drive on the "wrong" side of the road, not us Brits.

The vast majority of the world's population drives on the natural side of the road—the left-hand side. There is a logical explanation for this: most people are right-handed!

In days of yore when we all went about on foot or horseback, we approached things and people from the left, in order to keep our right hands free to greet or otherwise engage the object of our attention.

It was an unintentional twist of fate that led to the absurd transposition of right-hand-oriented road traversal from the natural left-hand mode. Napoleon, when he was going about his chores of war, ordered his armies to march two abreast on the extreme right of the road, in order to minimize the inconvenience to the local traffic. His picking the right-hand side was in fact quite arbitrary. But newly conquered na-

**The performance of a graphics adapter is a result of VSLI, BIOS, and software driver design. Varying Tseng chip performance levels can be attributed to these factors.**

tions believed that Boney required them to traverse their roads right-side-wise, as per the victorious French forces.

It is believed by American and non-British Europeans that the British Isles are out of step with the majority of the world. Not so—the boot is on the other foot.

I trust that Mr. Bican will now refrain from taking cheap and dexterous swipes at us Brits.

Sean O'Connell  
Oxon, England

### CORRECTIONS & AMPLIFICATIONS

Although the HeadStart Technologies HeadStart III AT-Compatible computer reviewed in "286s: No Frills, Few Thrills," *PC Magazine*, September 12, 1989, had an FCC Class A certification, current machines have a Class B rating, making them suitable for home use. The price of the machines has dropped to \$2,699 for the basic system and \$3,399 with a VGA monitor and card. The Tussey Computer Products Swan 286/12, reviewed in the same story, allows 5 megabytes of memory on the motherboard, not 1MB as reported.

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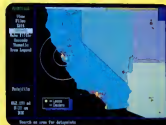
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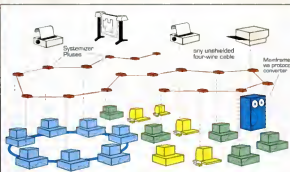
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# Advisor

## DRAWING A BLANK

Where can I get a background screen-blanking utility?

Dean L. Hiller  
Sterling Heights, Michigan



First, paw through the software currently on your shelf—utility or menuing software occasionally contains a screen-blanking program. Similarly, many of the shells for *Microsoft Windows* contain screen savers.

If this search fails to turn up anything, you have several options, depending upon what your needs are. You can find several free but limited programs in the Video data library of the IBMHW forum on CompuServe. The best of these is BURN-OUT (named BRNOUT.ARC). BURN-OUT allows you to perform hotkey or background blanking, in all text modes, and takes between 2K and 4K of RAM. You can disable but not unload it. In addition, the program's documentation provides a good explanation of how screen blankers work. NOYB.ARC is a TSR strictly for hotkey-triggered blanking. It works only in 80-column text mode and can't be disabled or unloaded. SCRN-SAVE.COM (named EGASAV.ARC on CompuServe), also free, will blank the screen after a specified interval of disuse and allow hotkey blanking. You can disable this program, but you can't unload it.

Of the commercial offerings, Revolution Software's *VGA Dimmer* (\$29.95; 715 Route 10 East, Randolph, NJ 07869; (201) 366-4445) is a flexible screen blander that allows hotkey blanking, timed blanking, disabling, and unloading (all 3K of it) from memory.

If what you're really interested in is a screen saver, an amusing alternative is *Whereabouts*, by The Mouse Artist Software (\$24.95; 45 Lakeside Ave., #38, Marlboro, MA 01752; (508) 485-9530). *Whereabouts* provides various EGA graphics screens depicting the whereabouts of the user, information on when the user will return, or a forwarding phone num-

■ **DRAWING A BLANK:**  
Blanking your monitor's screen.

■ **THE 720K VS. 1.44MB CONUNDRUM:**  
Formatting 720K floppy disks for 1.44MB.

ber. The screens fade in and out to prevent burn-in.

## THE 720K VS. 1.44MB CONUNDRUM

I've heard that the only difference between a 720K and a 1.44MB floppy disk is a small hole. Is this really the only difference, are there any products that will put this hole in a 720K disk, and do you recommend the process?

Vernon Moore  
Hong Kong



Ever since high-density floppy disks appeared, users have been arguing about the merits of doctoring double-sided double-density (DS/DD) disks to use instead of the high-density (DS/HD) disks that command steeper prices. To evaluate both sides of the debate, you need a general understanding of how disk drives and magnetic media operate.

Inside the square plastic case of a floppy disk is the *platter*, a circular sheet of plastic coated with an extremely thin layer of metal-oxide particles. The strength of the force required to magnetize these particles is measured in *oersteds* and is referred to as *coercivity*. A 5.25-inch DS/DD floppy disk has a coercivity of 300 oersteds, while the coercivity of a DS/HD is 600 oersteds. The coercivity of a 720K floppy disk, however, is 600 oersteds, as opposed to approximately 700 oersteds for a 1.44MB floppy disk.

The magnetic field flows in a given direction around each particle—say north

to south. Now imagine two neighboring particles with different polarities; the fields around the particles will flow in different directions.

When reading a disk, the drive head senses the change in the field directions between a pair of particles—called a *pulse* or *flux transition*. Each flux transition is counted as a 1; the lack of a transition is counted as a 0. Since higher-coercivity magnetic bits are less prone to being affected by their neighbors' fields, they can be packed together more closely, yielding thinner pulses at a higher frequency.

When you're writing to a disk, an electric current running through the head changes the polarity of selected particles, which in turn changes the pattern of flux transitions. You want the write current to be the appropriate strength to fully polarize the bits. Too low a current will result in an undersaturated particle, in which the electrons are not all lined up evenly in the same direction. Too strong a current will cause oversaturation, in which the current spills over to partially polarize neighboring bits. Over- and undersaturation reduce signal resolution.

The period of time that the head has to determine whether or not there is a flux transition—the *data or bit window*—lasts about 950 nanoseconds. You get the highest resolution signal when the pulse occurs in the middle of the interval, and resolution decreases as the pulses occur earlier or later in the window (after 200 or 949 ns., for instance, rather than 475).

What are the implications? For one thing, a high-density drive head uses a write current optimized for higher coercivity media than a low-density drive head, increasing the chances of improper saturation. Bits move around when under- or oversaturated, making it more likely that the pulse will occur too early or too late in the window, or even move out of the window entirely. Once the pulse is out of the window, the head won't register it, and you've pretty much trashed the disk. Furthermore, if you try to overwrite data

## Advisor

with an undersaturating current, you won't fully erase the previous information.

If you've ever had problems writing to a DS/DD disk (formatted as low-density) in a high-density drive, then you have first-hand experience with the saturation problem; downwardly compatible high-density drives are really downwardly read compatible.

That's a worst-case scenario. Under normal circumstances, when you initially format the disk, you might lose about 200K as bad sectors, and another 200K might be marginal, ready to go at any moment.

To prevent users from formatting DS/DD disks at the higher density, some 3.5-inch floppy disk drives check for a small square hole in the upper-left-hand corner of a DS/HD disk's case. A number of enterprising users tried drilling a hole in their DS/DD disks and successfully fooled the drives; you have to be careful when doing this, however, because minuscule plastic particles can get caught inside the

case and ruin the magnetic surface.

More-enterprising users discovered that by heating the plastic slightly or developing special hole-puncher-type devices, they could produce a clean cut in the case without worrying about stray pieces of plastic getting inside. Some users even started businesses with the sole intention of providing this service for others, and you can find their advertisements in the classified ads sections of *PC Magazine* and its peers.

I can't recommend any of these services over the others, however, because I can't in good faith recommend the process. Some people have never had problems using doctored DS/DD disks. This process works sometimes because the claimed coercivity levels are just averages; they differ from manufacturer to manufacturer and from batch to batch. Similarly, some drives are better than others; there are drives that can read and write almost anything you throw into them, while others can barely deal with the disks that you've formatted in them.

Others—myself included—have gotten burned. It really comes down to how much you value your data and how averse

to risk you are. If you really need to save money, you can use the DS/DD disks as scratch disks to transport files from place to place. But I strongly caution against using those disks for hard-disk backups or anything that can't quickly be recopied if the disk fails.

For a further explanation of disk drives and magnetic media, see *The Winn Rosch Hardware Bible* (\$29.95; ISBN 0-13-160979-3; Brady Books, Simon & Schuster Inc., Gulf + Western Building, One Gulf + Western Plaza, New York, NY 10023; call (212) 373-8500 for the book's distributor, Prentice-Hall). You can also look at *The Way Things Work*, by David Macaulay (\$29.95; ISBN 0-395-42857-2; Houghton-Mifflin Co., One Beacon St., Boston, MA 02108; (617) 725-5000)—a book no technophile's coffee table should be without.

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# First Looks

Hands-on Reviews of the Latest Products

## Tiny, Powerful Poqet PC Tips the Scales at 1 Lb.

PREVIEW  
by Jonathan Matzkin

If the diminutive Poqet PC delivers on its immense promise, it will be an epochal product, similar in impact to the original IBM PC and the first Compaq transportable. With its incredibly compact 1- by 8.75- by 4.25-inch (HWD) footprint and negligible 1-pound weight, the Poqet fits within some inside jacket pockets, making it convenient to use in places where the smallest laptops are impractical. And it runs DOS.

Poqet Computer's ambitious designers have attempted to do more than merely create a tiny DOS container, however. Almost as revolutionary as its size is the Poqet's complex power management scheme. The Poqet runs on two double-A batteries—that's right, the same ones that sell for a couple of bucks at the corner drugstore.

It may use the same batteries as your Walkman, but the Poqet PC has a much smaller appetite, according to its designers, who project a battery life of approximately 100 hours when the system is perfected. Taking a very aggressive approach to minimizing power consumption, the Poqet powers down the 80C88 processor whenever power needs are small, such as between keystrokes. The preproduction unit we saw did not incorporate all of the anticipated power management technology, however, and we observed less-spectacular battery performance.

Another energy-conscious  
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## Easel/2: A Power User's Answer To PM Application Development

HANDS-ON  
by Richard Hale Shaw

Programming the OS/2 Presentation Manager isn't easy. Only after programming in C for several years and acquiring a healthy knowledge of OS/2 can you begin writing PM applications. On top of that, there's the expense of development tools and the need to ensure that your programs comply with IBM's CUA (Common User Access) standard. With Interactive Images' *Easel/2*, however, application developers can write complex CUA-compliant applications without having to learn C or PM programming.

*Easel/2* is a robust, full-featured application development environment for the PM. You can use it to create PM applica-

tions or interfaces to remote applications on a PC, minicomputer, or mainframe. That's important in a programming world where multiple, interconnected hardware platforms present an increasingly common challenge.

At *Easel/2*'s heart are the EASEL programming language and Layout/CUA, a powerful, easy-to-use interface design tool for both programmers and power users. Layout/CUA converts the interfaces you design into EASEL programs that can be compiled into complete applications. The EASEL language's high-level approach masks the low-level details of PM programming from the developer and offers an object-oriented approach to PM windows, dialog boxes, and controls.

Each PM object can be defined, named, and grouped in classes, allowing you shortcuts toward completing an application.

Layout/CUA's WYSIWYG interface lets you visualize an entire application as you develop it, making it a snap to incorporate PM objects into a program. Each time you create a new interface, Layout/CUA opens a new, CUA-compliant window with the standard "File" and "Edit" entries and pull-down menus on the action bar. You can edit this and add additional windows and dialog boxes.

It's easy to add a control object to a dialog box. As you would with a paint program, you select the control from a palette and place it in the inter-

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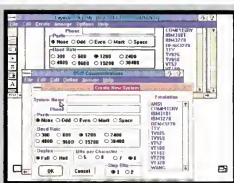
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### Easel/2

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face. Layout/CUA changes the mouse pointer to reflect the type of object, so you can position more than one at a time. Double-click on the object and you can edit its attributes—name, text content, and whether it invokes a dialog box when selected. If you indicate yes for the last, Layout/CUA displays a list of available dialog boxes to choose from. Thus it's easy to link different objects, keep track of them and their relationships, and create general-purpose objects (like dialog boxes) that can be used throughout the program. You can cut and paste objects to and from the PM Clipboard, so that they can be used in other interfaces or pasted into a word processor to create program documentation.

Once you've defined an interface, Layout/CUA converts it to EASEL code. To manage objects like push buttons and modal dialog boxes, Easel/2 automatically creates subroutines to control user responses and actions to take. You can edit these or any other part of the source code file and introduce additional elements or process-



Easel/2's high-level programming language lets you create your own PM applications without learning to program in C. Here an Easel/2 application is displayed with EASEL source code.

ing to the application. Then you can compile the application and run it with Easel/2 or the Easel/2 runtime package.

Layout/CUA protects you from creating interfaces that violate the CUA guidelines. If you try to convert an interface that explicitly breaks a CUA rule, you'll be greeted by an error message and a list of offending objects. If CUA allows an exception, the program will warn you and offer guidance. Thus you aren't required to know the details of CUA, just

its spirit, and you're free to concentrate on designing the interface.

With Easel/2's object-oriented approach to PM programming, you can name each object and define its response, for example; which events it responds to (like a keystroke); and which actions it takes. In addition, you can create classes or subclasses of objects, add and delete class members dynamically, and issue commands to an entire class. For example, if you have a class of screen buttons, you can change the button colors by changing the color of the class. Or you can create a response for a class of keys that retrieves a member's value when it is pressed—instead of defining a response for each key.

Because of this object-oriented approach, the EASEL language is largely descriptive. It includes over 100 commands for defining and manipulating PM screen objects, drawing graphs, and working with text. Visually, EASEL resembles a hybrid of COBOL, C, and Pascal, with the standard control-flow statements, constants, literals, a host of operators, and four types of variables. It includes over 60 built-in functions for querying objects and responses, and library routines for file handling and math. Simple EASEL commands let you call OS/2 dynamic link libraries; in-

terface with the PM Clipboard; read .PCX, .BMP, and text files; and run non-PM programs asynchronously (via OS/2's multitasking).

The EASEL language lets you write PM applications that are event-driven and dynamic; you can leave some components of an interface undefined until runtime. Thus, if a pull-down menu must include a list of reports that change periodically, it can be generated when the user runs the application.

Easel/2 supports asynchronous communications, with additional modules for 3270 and 5250 support. A version from IBM, which recently acquired an equity position in Interactive Images, supports the OS/2 Extended Edition Communications Manager. In addition, a Business Graphics module is available for converting tables to full-color business graphics.

Although Interactive Images offers an extensive training program, savvy programmers will be able to leverage the tutorial and sample applications that come with the program. And while the list price of \$7,500 for the software and documentation seems exorbitant at first glance, it's actually quite reasonable, considering the years of C and OS/2 programming experience it makes up for. Considering all that it does offer, it won't be a surprise if Easel/2 becomes the premium PM programming environment for non-PM programmers. ■



Easel/2's Layout/CUA interface design tool lets you render the entire interface of an application, adding dialog boxes, windows, and PM controls as needed. Here, Layout/CUA is editing the interface while the completed application runs in the foreground.

### FACT FILE

**Easel/2**  
Interactive Images Inc., 600 W. Cumminge Park, Woburn, MA 01801; (617) 938-8440.  
List Price: \$7,500 for development system, \$350 for runtime system.  
Requires: 80286- or 80386-based PC, 1MB RAM beyond that required by OS/2, hard disk, EGA or later, OS/2 1.1. In Short: A comprehensive, robust Presentation Manager application-development environment for programmers who have no previous experience in C or OS/2.

CIRCLE 448 ON READER SERVICE CARD

## First Looks

### Poquet PC

CONTINUED FROM PAGE 33

design decision calls for the use of static rather than dynamic RAM for the Poquet's standard complement of 512K: SRAMs require less power than DRAMs. When the Poquet is powered down with its keyboard-mounted on/off switch, the system continues to supply enough power to RAM to preserve the contents of memory. You can jot down a quick note in your word processor, turn off the machine, and return to the place in your application where you left off with another tap of the switch. A recessed reset button initiates the equivalent of a cold boot, with the loss of RAM contents.

The Poquet's innovations continue beyond size and miserly power consumption. Instead of accepting the weighty extra baggage of standard floppy and hard disk technology, Poquet has turned to solid-state RAM and ROM cards, much like those used by NEC in its comparatively gigantic UltraLite.

About the size of credit cards, the RAM cards contain static RAM and small lithium batteries to preserve data. The ROM cards are the same size but do not require batteries. The RAM and ROM cards fit into drawers in the side of the Poquet's case—about where you would expect to find conventional drive bays.

Poquet Computer has been working with software vendors to develop ROM versions of a variety of popular applications, including *WordPerfect 5.0*, *Write III Plus*, and *Q&A*. Poquet is also developing a special ROM execution capability that could greatly increase the power and flexibility of the machine. ROM-executable applications will run almost completely in memory supplied on the ROM card itself.

That makes the Poquet's non-expandable 512K of system RAM look considerably larger than it is. With a spreadsheet

running from the ROM card, almost all of system RAM would be available for worksheets or a RAMdisk. Poquet Computer had no ROM-executable applications ready at the time of this writing, but the company says it will have *Lotus 1-2-3*, *AlphaWorks*, and *Lucid 3D* available in the time the Poquet PC comes out on the market.

Alpha Software's formal announcement of *AlphaWorks* for

With many larger laptops failing to provide high-quality displays, you might expect the Poquet to stumble as well. But the 7-by-3-inch, 80-column by 24-line LCD screen is quite readable. Contrast is easily adjusted from the keyboard. The display emulates MDA and CGA graphics, with results quite similar to other CGA-compatible LCD displays. Poquet Computer promises a still-better image by the time the

agement system. The keys were loosely secured to the switch assemblies, and the keycaps had enough play that they easily became stuck under one another. The unit had other fit and finish problems, which Poquet says will be ironed out before the product ships.

Another problem is the Poquet's price structure. At \$1,995, it's an expensive machine. It comes with a single 32K RAM card, which isn't a great deal of storage. Prices for additional memory are stiff. A single 64K storage RAM card will set you back \$160, and a 256K card costs \$375. 512K of RAM on a card will cost you \$595.

That high start-up cost does buy you some needed accessories. Poquet includes a null modem cable for transferring files from your desktop machine through the Poquet PC's proprietary expansion port. Quite a bit of useful software is also standard. The machine comes with *PoquetTools*, a memory-resident assortment that includes a modem package, a word processor, and a calculator. Along with DOS 3.3, BASIC, *PoquetTools*, and the system BIOS, you also get *PQ-Link*, a file-transfer program that resides in 640K of your ROM.

The preproduction unit comes very close to realizing the potential of its design. If the production-level release of the Poquet PC incorporates the changes its manufacturer promises, it's bound to change the way that many people look at personal computing. ■



The Poquet PC uses credit-card-sized RAM and ROM cards in place of conventional disk drives. RAM cards will come in sizes up to 512K.

the Poquet is an encouraging sign that software support is on the way. *AlphaWorks* is an appropriate first title for the Poquet. An integrated package with a significant user base on full-sized PCs, *AlphaWorks* combines six applications. It offers a word processor, a *dBASE III Plus*-compatible database, and a *Lotus 1-2-3*-compatible spreadsheet with graphics. There is also a communications module.

Executing from ROM, this suite of applications gives the Poquet user access to all of the basic software tools of the desktop. As other titles are announced, the Poquet's size and DOS compatibility could make it look like that elusive dream of the mobile power user: a unit that offers advanced functionality with no penalties of size or weight.

machine ships.

What is problematic is the Poquet's keyboard. The design is functional but cramped, which means that people with large hands will not be able to rest all their fingers comfortably on the keyboard. With some practice and patience, though, you should be able to touch-type at a reasonable speed with a keyboard of this size.

In fact, size is the least of the keyboard's problems. The prototype we examined was just barely functional. Repeated keypresses often produced no response, and a single keypress sometimes generated multiple characters. Occasionally, tapping a letter key would unexpectedly power down the machine—a glitch that can probably be attributed to the not-yet-perfected power man-

**FACT FILE**

The Poquet PC  
Poquet Computer, 201 San Antonio Circle, C-250, Mountain View, CA 94040; (415) 948-6688.  
List Price: \$1,995; 64K RAM card, \$160; 256K RAM card, \$375; 512K RAM card, \$595.  
In Short: In addition to its tiny size, the Poquet PC offers innovations in power management and data storage. Prototype suffers from some fit and finish problems.

CIRCLE 431 ON READER SERVICE CARD

## First Looks

# IBM Personal Page Printer II Features Three Emulations

HANDS ON  
by Mitt Jones

IBM's first stab at a PostScript printer may have legitimized PostScript within the PC industry, but the IBM Personal Page Printer itself was more notable for its faults than its virtues. With its latest PostScript offering, IBM completes an admirable redesign effort that may make the Personal Page Printer II one of the more popular PostScript printers going.

Still based on Ricoh's 6-page-per-minute engine, the \$4,999 Personal Page Printer II Model 031 not only resolves the shortcomings of the original, but also adds a few innovative features most of the competition forgot.

Chief among the Page Printer II's attractions are its three emulations. While the original could emulate only IBM's own ProPrinter, the Personal Page Printer II emulates the ProPrinter, the HP LaserJet Plus, and the Diablo 630.

To enable users to pick their emulation of choice as painlessly as possible, IBM also added automatic emulation switching, a touch that should prove especially handy in network installations. The printer requires only one of the host PC's ports, but it assigns each of the logical ports, LPT1 through LPT4, to a different emulation. A utility allows you to change or disable the associations easily.



The Page Printer II offers automatic emulation switching.

As if this acknowledgment that other printers exist were not enough, IBM has taken its newfound spirit of glasnost one step further by building an AppleTalk network connector into the printer, alongside the parallel and serial connectors.

Many of the other improvements revolve around the integration of PostScript-specific components into the printer housing. Every PostScript printer requires an interpreter and a processor to handle the conversions. The original Page Printer coupled a "dumb printer" to a full-length adapter that housed the processor and required RAM. It relegated the interpreter and 29 of the printer's 42 fonts to the host PC's hard disk rather than holding them in ROM on the adapter.

While IBM was eager to point out that this design hastened data transfer and made Adobe interpreter revisions much easier, the arrangement


also tied up the host system for about 2 minutes at bootup while it loaded the interpreter into adapter RAM. And, before you could use any of the 29 fonts stored on your hard disk, you had to wait for the subsystem to download the outline, an annoyingly slow process.

In contrast, this version builds a 16.7-MHz Motorola 68000 processor, 2MB of RAM, and other hardware into the printer and holds its authentic Adobe interpreter, along with all of its 47 font outlines, in ROM. The printer still requires about 2 minutes of warm-up time, but your system isn't occupied by the processor as before.

This version also allows installation of an additional 2MB of RAM for a total of 4MB, more than enough to handle most complex print jobs.

As one final boon, albeit an expensive one, IBM is offering a sheet feeder for the Page Printer II. The \$1,395 sheet feeder, which measures nearly 6 inches deeper than the printer and about an inch wider, looks a bit like a flat-bed trailer holding the Page Printer as cargo. With two 200-sheet paper bins and a 50-envelope tray, however, the sheet feeder may be well worth its bulk for corporate uses, especially in light of the Page Printer's normal capacity of only 150 pages.

In testing, the Page Printer II performed well, if not spectacularly. Compared with the other PostScript printers reviewed in this issue, the tested 5-ppm

**FACT FILE**

**IBM Personal Page Printer II Model 031**  
IBM Corp., Contact your nearest authorized dealer; (800) 447-4700  
**List Price:** \$4,999; upgrade from Model 030, \$750; 2MB additional RAM, \$1,495; Personal Page Printer II Sheet Feeder, \$1,395  
**Dimensions (HWD):** 8.5 x 33 x 17.4 (includes trays)  
**Weight:** 35 lbs.  
**Emulations:** Postscript, HP LaserJet Plus, IBM ProPrinter XL, Diablo 630.  
**In Short:** A versatile 6-ppm PostScript printer with 47 built-in fonts, three automatic emulations, maximum RAM capacity of 4MB, and AppleTalk support.

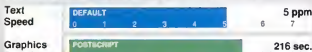
CIRCLE 443 ON READER SERVICE CARD

speed of the Page Printer II places it ahead of the slowest of the lot but still on the slow end of the spectrum.

The Page Printer handled LaserJet Plus emulation well overall, but botched minor aspects of the test. For instance, while it did a beautiful job with shading, hatching, and working with a downloaded font, it failed to compensate for the quarter-inch difference in page margin between it and the LaserJet Plus.

The Personal Page Printer II offers a wealth of features in a package that is well thought out and well implemented. Its automatic emulations and AppleTalk support make it a versatile choice for single-user applications or small networks. With a tested speed of only 5 ppm, however, the Page Printer II may prove too limited for large-scale network duty. ■

## IBM Personal Page Printer II Model 031



Once you've torn down all of the laws in the country and you find yourself face to face with the Devil, what will you hide behind? **Courier Bold Underlined** **Palatino Bold Underlined**





## First Looks

# Toshiba PageLaser6: A Low-Cost Alternative

HANDS ON  
by Jonathan Matzkin

If HP is far from alone in the laser market these days, the LaserJet Series II nevertheless remains the standard for workhorse nonimpact printers. Toshiba America Information Systems' new entry in the compatible derby, the Toshiba PageLaser6, aims to provide that critical HP compatibility, along with some new wrinkles of its own and a low price.

The \$1,899 PageLaser6 packs a 6-page-per-minute engine and comes with a 150-sheet paper cassette. Like the LaserJet II, the PageLaser6 offers 300-dot-per-inch resolution, and Toshiba's machine accepts standard LaserJet II cartridges in its two slots. Toshiba warns that some third-party cartridges may not work.

The PageLaser6 has 512K of standard RAM and supports upgrades of 1MB (\$499), 2MB (\$999), and 4MB (\$1,999) for those monster graphics jobs.

Noticeably more compact than the LaserJet II, the PageLaser6 measures 8.5 by 16.1 by 15.4 inches (HWD) and weighs 35.3 pounds. Rather than the commonly found Ricoh or Canon laser engine, Toshiba opted for technology from TEC (Tokyo Electric Co.). The PageLaser6 gives away 2 ppm to the LaserJet II but is rated at 2 ppm faster than the Series IIP,

HP's economy model. In PC Labs benchmark testing, the PageLaser6 clocked in at a respectable 5.7 ppm.

The PageLaser6 also generates respectable output. In our graphics test, in which the printer reproduces a scanned photo, the Toshiba produced results that stand up next to those from any printer in or near its price range. Blacks were dark and

The PageLaser6 offers HP compatibility and some new twists.



solid, and the PageLaser6 handsomely reproduced a good range of gray shades.

The unit sailed through tests for compatibility with the LaserJet II, and the PageLaser6 worked well with several applications configured with Series II drivers. Given the widespread availability of HP drivers, the PageLaser6 should not lack for compatible software.

Toshiba goes beyond HP a bit by offering an internal Prestige typeface. Unfortunately, Toshiba's otherwise outstanding documentation fails to list the HPPCL control codes neces-

sary to access the Prestige fonts. So Prestige-conscious users will have to wait for software developers to offer custom drivers for the PageLaser6.

Despite this one annoying omission, the manual is excellently written. Toshiba supplies a brief, nontechnical, and instructive description of laser printer technology. Even better is the section on initial installation of the consumables and setup of the printer. The language is bell-clear, and the instructions are keyed to easily identifiable landmarks inside the unit.

Like the Series II, the PageLaser6 has a knob on the inside of the printer housing that lets you control print density. The

adjustment range isn't very broad, but different settings did have a visible effect on the output darkness.

Unlike the Series II, the Toshiba printer uses separate, replaceable drum and toner cartridges. The toner, which Toshiba estimates has a 3,000-page lifespan, costs \$49. A new drum, with an estimated lifespan of 10,000 pages, costs \$149.

The PageLaser6 sports a control panel similar but not identical to that of the LaserJet II. An array of plastic membrane switches sits to the right



## FACT FILE

### Toshiba PageLaser6

Toshiba America Information Systems Inc., Computer Systems Division, 9740 Irvine Blvd., Irvine, CA 92718; (714) 583-3000.

List Price: \$1,899; 1MB memory card, \$499; 2MB memory card, \$999; 4MB memory card, \$1,999; toner cartridge, \$49; drum, \$149; rear output tray, \$39.

Dimensions: 8.5 x 16.1 x 15.4 in.

Weight: 35.3 lbs.

Emulations: HP LaserJet II, IBM Proprinter XL24

In Short: A compact, solidly performing alternative to the LaserJet II at an eye-catching low price.

CIRCLE 448 ON READER SERVICE CARD

of a 1-line, 16-character LCD display. Setting options such as emulation, number of copies, and type of interface presented little difficulty, but the LCD display could definitely use a boost in contrast; it was difficult to read in less-than-perfect lighting conditions.

The PageLaser6 employs a straight paper path, but the rear output tray necessary for this mode will cost you \$39. The LaserJet II's flip-down rear tray comes with the printer.

On price alone, it's tempting to compare the Toshiba PageLaser6 to the \$1,495 HP Series IIP rather than to the Series II. But the PageLaser6 is nearly 2 ppm faster than the IIP and has a standard paper cassette that's 100 sheets roomier. Thus, the more appropriate comparison is to the Series II, and it's a comparison that the price- and performance-conscious user should make.

## Toshiba PageLaser6



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## PC Macsyma: Mathematica Competitor Is Strong In Computer Algebra

HANDS ON  
by Barry Simon

*Macsyma*, the granddaddy of symbolic manipulation programs, has just been released for 386 machines. Based on a project started 20 years ago at the Massachusetts Institute of Technology, the new version, *PC Macsyma*, offers an impressive set of tools in computer algebra and is highly programmable. Priced at \$1,950, the program competes head-on with Wolfram Research's *Mathematica* but falls short of that program in some significant ways.

*PC Macsyma's* hardware requirements are awesome. The program requires 17MB of disk space, not counting 1MB for the runtime version of *Microsoft Windows* that comes with the program. It uses virtual memory and requires a minimum of 12MB of combined free RAM and swap-file space. If you want to produce hard copies of graphs, you'll need to run the program under the full version of *Windows*.

The combination of *PC Macsyma's* interface—essentially a command line displayed in a window—and *Windows* is analogous to a gorilla wearing a party dress. Although you can issue some powerful commands with confusing syntax like

```
translate(hach,check,iterate,FX,FQ,FH,GETL,criterion,accelerate)$
```

your ability to edit at this command line makes DOS look good. The only editing key at your disposal is backspace. While you can use *Windows* scroll bars to look at previous input and output, the only way to transfer any of that output to the current command line is to refer to the entire input or output of a previous line or to cut-and-

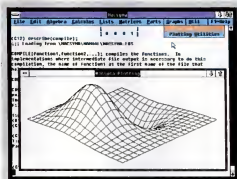
paste using the *Windows* Clipboard if you have a mouse.

In addition to scroll bars and the Clipboard, *PC Macsyma* makes use of *Windows*-style menus. You use the menus primarily to access the program's help system, which holds the keys to the most important commands. The menu bar features such topics as Algebra and Calculus, which in turn bring down menus of more-specific commands. Choosing a command invokes a dialog box that allows you to cancel a command, insert a command on the command line, or invoke an example or a command description. If you choose help, you'll be dumped out of the menu system onto the

In the category of computer algebra *PC Macsyma* offers a wider array of functions than *Mathematica*. For example, *Mathematica* will factor polynomials only modulo a prime for functions of one variable, while *Macsyma* allows functions of many variables. *Macsyma* provides a well-developed library of Laplace and inverse Laplace transforms, while *Mathematica* will be introducing these techniques in limited ways with Version 1.2.

*PC Macsyma's* biggest disappointment is its graphing capabilities. On-screen graphs are mediocre compared with *Mathematica's* displays. The problem gets worse. The only way to get hard copy is to paste a graph onto the *Windows* Clipboard as a bitmap and then paste it into *Windows Paint* or a similar program. Such a procedure guarantees that the printout will be at screen resolution rather than a higher printer resolution.

Undoubtedly, *Macsyma's* weakest link is performance on numerical calculations, which



*PC Macsyma* makes use of *Windows*-style menus and displays graphs in windows.

command line, where you'll see a description of the command in question.

*PC Macsyma* excels in computer algebra/symbolic manipulation and programmability, two of four elements that constitute a complete interactive mathematical environment. In the other two areas—numerical ability and graphics—the program doesn't fare as well.

is unacceptable if you plan to use the program for large calculations. Purely algebraic trial problems took comparable times with *Macsyma*, *Software's Derive*, and *Mathematica*, with *Macsyma* yielding the slowest times of the three. But factoring an 18-digit integer took *Derive* and *Mathematica* less than 15 seconds to complete, while *Macsyma* took



### FACT FILE

*PC Macsyma*, Release 415.25  
Symbolics, Computer Aided Mathematics Group, 8 New England Executive Park, East Burlington, MA 01803; (617) 221-1250.

List Price: \$1,950; \$1,250 for academic institutions; steep volume discounts available for academic institutions.

Requires: 60386-based PC, 4MB RAM, 17MB hard disk space (8MB additional RAM or disk space recommended), DOS 3.0 or later.

In Short: An impressive set of tools in computer algebra with powerful programmability. Marred by poor graphics and slow numbers. Copy protected.

CIRCLE 442 ON READER SERVICE CARD

26 minutes. Inverting a 17 by 17 Hilbert Matrix took *Mathematica* 7 seconds and *Derive* 5 seconds. When I tried to solve the same problem with *Macsyma*, I had to stop the calculation after 4 hours. When I tried a different method, *Macsyma* solved the problem in 87 seconds.

On top of its performance problems, *PC Macsyma* is copy protected with a block that attaches to your parallel port. The block is supposed to be pass-through, but I was unable to run the *Brooklyn Bridge* file transfer program through a port with the block on.

Much to *PC Macsyma's* disadvantage, Symbolics has taken a solid but somewhat-out-of-date kernel and then used barely adequate resources to port the program to the PC. This comes through in the program's poor use of *Windows*, its inadequate printing support, and the fact that it will not work with such memory managers as *QEMM-386* or *386-to-the-Max* because the version of *Phar Lap's 386/DOS-Extender* it employs is over a year old.

If you need one of *Macsyma's* unique functions and your problems are either small or nonnumerical, this is the product you'll want. Otherwise, given its cost, slow performance, and copy protection, another product in this market is likely to be a superior choice. ■

## First Looks

# Toshiba T3200SX: Fast, Functional, and Expensive

HANDS ON  
by Lori Grunin

Slipping neatly into the niche between the 286-based T3200 and the 386-based T5200, the relatively powerful Toshiba T3200SX sports the features any 80386SX-based portable should have.

Unfortunately, Toshiba's initial price of \$6,299 puts the T3200SX into competition with 16-MHz 386-based portables rather than with the 286- and other 386SX-based machines will be comparing it.

In the standard configuration of the 17-pound AC-powered portable, you get a 25-millisecond 40MB hard disk drive and

1MB of 80-nanosecond memory expandable to 7MB or 13MB on the motherboard using 2MB or 4MB SIMMs. This combination results in good but not outstanding performance.

Installing additional memory or an 80387SX math coprocessor requires removing five screws and pulling off the keyboard—not too arduous a task.

On the other hand, installing a standard PC board in one of the two slots (one a full-size 16-bit, the other a half-size 8-bit that doubles as a proprietary 16-bit) is somewhat trickier: you have to remove several metal plates and a plastic cover. A dedicated, proprietary modem slot is easier to get to.



The T3200SX features a 16-gray-shade gas plasma VGA display.

The T3200SX uses the same 16-gray-shade gas plasma VGA display as the T5200 but has the same nondetachable design as the T3200, with LED indicators located on the hinge. It looks fine in office-type overhead fluorescent lighting and dimly lit rooms, but if you ever need to adjust the contrast, you're out of luck; the brightness control provides little or no variation. You can also use an external VGA monitor simultaneously with

the gas plasma screen.

Although it was unavailable at review time, Toshiba will be including a TSR (similar to the one that comes with the T3200) that lets you alter the mapping of color to gray shades to improve the display.

Other standard features include a 1.44MB floppy disk drive, two serial ports, and one parallel port that performs double-duty for either an external floppy drive or a printer. If you dislike the 91-key keyboard, you can plug your favorite replacement into the external keyboard port. And if security is an issue, you can slip a lock through a tab on the T3200SX and chain it to your desk.

Toshiba bundles DOS 4.01, QEMM-386, and the PC-Kwik PowerPak with the system; OS/2 1.0 costs an extra \$325. Product support includes a toll-free hotline and a one-year limited parts-and-labor warranty.

All in all, the T3200SX is a good machine for people who want an office computer that they occasionally need to lug home, but not a clear winner in an increasingly crowded field. ■

## BENCHMARK TESTS: TOSHIBA T3200SX

Although the Toshiba T3200SX shares the design of the 286-based T3200, the 16-MHz 386SX-based machine's performance comes closer to that of the T5100, which uses a 16-MHz 386 processor. Overall, it holds its own in the company of the desktop 386SX machines we looked at in our August 1989 issue.

The 80386 Instruction Mix benchmark test times a series of tasks specific to the 80386 chip. Since this test shows how the CPU operates in the context of the bus, processor, system memory, and motherboard architecture, a faster time means better overall computer performance.

The Conventional Memory benchmark test measures the read/write speed of the first 640K of memory. Slower relative times can indicate the presence of memory wait states or memory chips rated at slower access speeds.

The DOS File Access (Small Records) benchmark test times disk throughput as a result of mechanical disk drive speed, hard disk controller

function, and bus speed. The test is performed without software disk caching. Fast times are advantageous for programs that work with short segments of data.

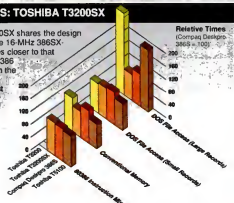
The DOS File Access (Large Records) benchmark test times disk throughput as

a result of mechanical disk drive speed, hard disk controller function, and bus speed. This test minimizes the effect of small hardware caches on disk subsystem performance. It is performed without software disk caching. Fast times are advantageous when large files are loaded.

Performance Times  
(Times given in seconds)

	80386 Instruction Mix	Conventional Memory	DOS File Access (Small Records)	DOS File Access (Large Records)
Toshiba T3200	N/A	0.86	58.44	18.40
Toshiba T3200SX	4.55	0.66	61.18	5.89
Compaq Deskpro 386S	4.48	0.83	64.04	7.31
Toshiba T5100	4.28	0.63	52.64	14.01

N/A—Not applicable. The Toshiba T3200 uses an 80286 processor.



## FACT FILE

### Toshiba T3200SX

Toshiba America Inc.,  
Computer Systems Division,  
9740 Irvine Blvd., Irvine, CA  
92718; (800) 457-7777, (714)  
583-3000.

List Price: \$6,299.

In Short: A fast and functional—if slightly overpriced—addition to Toshiba's line of sturdy portable computers.

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PHOTOGRAPH: THOMSON/CORBIS

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- Includes all standard features, plus:
- INTEL 32-BIT 80386 20MHz CPU
  - 1MB RAM (384K FOR SHADOW RAM, EXPANDABLE TO 16MB ON BOARD)
  - LIM EMS V4 SUPPORT
  - SUPPORTS 80387-20 OR WEITEK 3187 CO-PROCESSOR
  - CACHE MEMORY OPTIONAL

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"Only if you're flush with cash or restricted to buying from one of the well-known makers like IBM or Compaq should you pass up considering the CPU 386." —July 1989

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  - LIM EMS V4 SUPPORT
  - SUPPORTS 80387-25 OR WEITEK 3187 CO-PROCESSOR
  - CACHE MEMORY OPTIONAL

### CPU 286/12 \$795 BASIC SYSTEM



"Don't pass over the CPU 286 12MHz." —Sept 1989

### CPU 286/20 \$995 BASIC SYSTEM

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- HARRIS 80286 20MHz CPU
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4386/28MS MFM	\$ 500	\$ 680	\$ 940	\$1,115
6686/24MS MLL	\$ 635	\$ 815	\$1,075	\$1,250
7146/24MS MFM	\$ 810	\$ 990	\$1,250	\$1,425
7246/24MS MLL	\$ 860	\$1,040	\$1,300	\$1,475

	MONO 720X348	16 BIT VGA MONO 640X480	16 BIT VGA COLOR 640X480	16 BIT SUPER VGA 800X600
1586/23MS ESD	\$1,280	\$1,460	\$1,720	\$1,885
2206/20MS MLL	\$1,850	\$2,030	\$2,290	\$2,465
2206/18MS (30H 51.5)	\$2,250	\$2,430	\$2,690	\$2,865

\*Special prices listed available only with purchase of complete systems.

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## 186 CONFIGURATION CHART

(Add basic system price to the monitor/disk combination of your choice)

	MONO 720X348	VGA MONO 640X480	VGA COLOR 640X480
20MB/65MS	\$385	\$565	\$650
40MB/28MS	\$525	\$705	\$990

\*Special prices listed available only with purchase of complete systems.



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## First Looks

### ProCube Instantly Transposes 3-D Spreadsheet Data

HANDS ON  
by Craig Stinson

This year, the big guns of the spreadsheet business—*Lotus 1-2-3*, Release 3; *SuperCalc 5*; and the just-announced *Quattro Pro*—have jointly proved the value of multipage modeling and have made three-dimensionality an essential feature of top-flight spreadsheet programs.

One little gun that has been focusing on three-dimensionality for some time is FormalSoft,

512 pages, has beefed up the macro facilities, and has added a graphing module (from Media Cybernetics) in the form of a detachable TSR. The new product's claim to fame, however, is a set of View commands that instantly transpose and reorient three-dimensional data.

Picture a worksheet that tracks expense figures by time period for each of several company divisions. The expense categories are in rows and the periods in columns, and each page of the file has been sup-

would be more trouble than it's worth. But with *ProCube*, the rearranging is effortless and error-free.

*ProCube* invites you to think of your three-dimensional data as a sort of Rubik's Cube. When you begin working with a model, you are said to be looking at the front face of the cube. The View Right and View Top commands rotate the cube 90 degrees, giving you the two transpositions described above.

The metaphor comes apart, however, when you ask to see the back, left, or bottom of the cube. Strictly speaking, the back face should have the same layout as the front, but with the left-right order of the columns reversed. Instead, *ProCube*'s back face shows your data paged in the same way as its front face, but with the row data displayed in columns and vice versa. The left and bottom faces offer similarly shuffled versions of the right and top faces.

Two other *ProCube* attractions are worth singling out. The first is a page-look-up function, which lets you create an array of look-up tables with each table on its own page. The function uses the upper-left-corner cell of each page as an index value and accepts both column and row offset arguments. This function has no direct counterpart in most other spreadsheet programs; it is handy for applications, such as determining payroll deductions, that require choosing among multiple tables before looking up values.

The second attraction is an unusually rich application tool kit. Macros, which reside in separate disk files, can be recorded as well as created through an editor, can be assigned to any keys (including the function keys in all shift states), and can be triggered by events in the spreadsheet. Thus, you can have a certain macro run only when the user enters an out-of-bounds value in a specified cell.

This feature, combined with macro statements specifically tailored for user assistance (verbs that plant text windows on-screen and/or create custom help and error messages), gives the *ProCube* programmer a leg

up in developing applications for the novice user.

These strengths aside, however, *ProCube* is beset with limitations. Because pages extend only to 512 rows, users will be unable to import deep models created in other programs. (*dBASE* files with more than 512 records are split across pages on import, but deep 1-2-3 files are simply truncated.) Compatibility with other programs is incomplete; 1-2-3 macros are not translated, and a number of commands and navigational keystrokes differ from the industry standards in arbitrary ways.

*ProCube*'s graph module is slightly more advanced than that of 1-2-3, Release 2.2 (it includes a high-low type option and some 3-D perspective choices), but not enough to matter. And there are no data-query commands at all. *ProCube*'s brute-force recalc times, moreover, compare unfavorably with those of other spreadsheet programs.

*ProCube* offers analytical perspectives that are difficult to achieve in other spreadsheets. This fact, combined with the package's relatively low list price, may justify acquiring *ProCube* as an adjunct to more-versatile programs, such as 1-2-3 or *SuperCalc*. But for routine number-tracking tasks that don't require its multiple-perspective talents, *ProCube* comes up short.



The screenshot shows the 'Right Side of Worksheet' window. It displays a menu bar with 'File', 'Edit', 'View', and 'Help'. Below the menu is a toolbar with icons for 'Right', 'Left', 'Top', 'Bottom', 'Back', and 'Front'. The main area shows a table with columns for 'Jan 83', 'Feb 83', 'Mar 83', 'Apr 83', and 'Total'. The rows are labeled 'Rent', 'Utilities', 'Phone', and 'Food'. The data is presented in a grid format with numerical values.

	Jan 83	Feb 83	Mar 83	Apr 83	Total
Rent (USD)	\$280.00	\$210.00	\$270.00	\$250.00	\$1010.00
Utilities (USD)	\$100.00	\$150.00	\$120.00	\$130.00	\$500.00
Phone (USD)	\$250.00	\$150.00	\$120.00	\$130.00	\$650.00
Food (USD)	\$250.00	\$250.00	\$250.00	\$250.00	\$1000.00
Total (USD)	\$880.00	\$760.00	\$760.00	\$760.00	\$3160.00

*ProCube*'s WorkCube, View command lets you look at a worksheet from six different perspectives.

an erstwhile shareware firm. In the February 16, 1988, issue of *PC Magazine*, FormalSoft's *QubeCalc*, a 64-by-64-by-64 shareware worksheet with some unusual data-slicing features, was awarded an Editor's Choice designation in a roundup of low-end spreadsheet programs ("Spreadsheets for Modest Proposals"). Now, with *ProCube*, the company has plunged boldly into the mainstream spreadsheet market.

Priced at \$247.50, *ProCube* is a completely rewritten subset of *QubeCalc*. FormalSoft has expanded the dimensions to 512 rows by 512 columns by

plied by a particular division manager. With a simple *ProCube* View command, you can instantly rearrange this information so that divisions are in columns and each page covers a particular quarter. A different View command lets you flip the structure, placing the divisions in rows and the time periods in columns and devoting each page to a single expense category.

Accomplishing these rearrangements in most spreadsheet programs would be an error-prone process requiring extensive use of transposition commands. For many users, it

#### FACT FILE

**ProCube**  
FormalSoft, P.O. Box 1913,  
Sandy, UT 84091; (801) 565-  
0971.

List Price: \$247.50.

Requires: 512K RAM (640K  
recommended), DOS 2.0 or  
later.

In Short: *ProCube* excels at  
analyzing three-dimensional  
data from all possible  
perspectives; its View  
commands instantly perform  
the equivalent of many tedious  
transpositions in other  
programs. For more-com-  
monplace spreadsheet work,  
however, *ProCube*'s 512 rows  
per page and limited 1-2-3  
compatibility may be liabilities.

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## First Looks

# ExcelMore Creates a Virtual Desktop in Windows

HANDS ON  
by Rock Miller

If Microsoft Windows' presentation limitations are your problem, *ExcelMore* may be the answer. This \$99 set of screen drivers takes advantage of advanced features of EGA and VGA chip sets to create a Windows desktop larger than your monitor's screen.

With an *ExcelMore* driver installed, you can create larger windows that show more information. You can move around within this "virtual desktop" with sweeps of the mouse, saving much laborious clicking on the scroll bars. Since *ExcelMore* uses the panning and scrolling features built into your video hardware, screen response is instantaneous.

In spite of its name, *ExcelMore* enhances any Windows application. It offers three color and two monochrome drivers. The landscape formats are excellent for viewing wide spreadsheets, while the portrait-format drivers are suited to working with drawing and publishing applications.

With the monochrome drivers, you can squeeze the display horizontally by a factor of two. This feature is a boon for managing the large work spaces *ExcelMore* creates. Though the compressed display is so fuzzy and discolored as to be barely readable on an EGA display (it's much better on a VGA display), it's good enough for moving windows around and gives you an acceptable bird's-eye view of large spreadsheets.

Since Windows won't let you install drivers from within itself, you must reinstall Windows completely for each *ExcelMore* driver you want to use. This is not difficult (though the skimpiness and inconsistency of *ExcelMore*'s documentation don't help), but it is tedious. Fortunately, once the drivers are installed, you can select

among them by running a program from the DOS prompt before starting Windows.

The new perspective *ExcelMore* puts on Windows takes some getting used to. Because you start out in the center of the visual field, menu selections tend to be off-screen. You can partially get around this problem by customizing your desktop. Unfortunately, customizing won't help the tendency of dialog boxes to pop up off-screen; you'll just have to train yourself to hunt for the box on

the appropriate occasions.

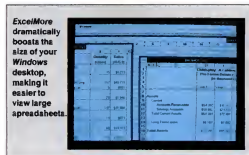
*ExcelMore* is not without compatibility problems. The company claims it works with all EGA and VGA cards except the Genoa, but some device drivers produce a black bar in the middle of the screen. And running the program that activates screen compression locked up my system until I removed my expanded memory manager.

Though no panacea, *ExcelMore* can be a big help if you commonly work with large spreadsheets or documents. ■

**List Price:** *ExcelMore*, \$99.

**Requires:** EGA or VGA video card, Microsoft Windows 2.x. Aristocad Inc., 1650 Centre Point Dr., Milpitas, CA 95035; (408) 946-2747.

CIRCLE 448 ON READER SERVICE CARD



## PageGarden: Programming Language for Lasers

HANDS ON  
by Edward Mendelson

Dan Bricklin's *PageGarden* has plenty of rich soil in which to grow laser-printed labels, invoices, badges, tickets, and other standardized or repetitive printing jobs, including listings and reports created from simple ASCII text files. Software *PageGarden*'s \$99.95 package is a programming language designed exclusively for formatting text on HP-compatible and PostScript laser printers, and it makes these printers do tricks that less-specialized forms generators and mail-merge programs can't imagine.

*PageGarden* works by interpreting a "description file" that

specifies the format, standardized text, and graphics elements to be printed on every page, plus the names of one or more standard data files containing the text to be formatted. These data files can be any ASCII text files created by an editor, database, or spreadsheet. You name the description file as a command-line parameter when you run *PageGarden*, and the program does its work without further intervention on your part.

The description file and data files resemble the main and secondary files in a mail-merge, or the style sheet and text files in a desktop publishing program, but *PageGarden* doesn't give you a graphics screen for designing a page or an editing

screen for modifying the text. You design the page with a pencil and paper. Then you use any text editor to create a description file, using *PageGarden*'s simple programming language to define each element in the page design.

If you ever learned to write a five-line BASIC program, you'll find *PageGarden*'s language even easier. You can get a quick start by modifying the almost 50 sample programs supplied on-disk. Prepare to waste reams of paper while debugging and fine-tuning a description file.

*PageGarden*'s language has commands for drawing lines, boxes, and circles; inserting and rotating PCX and EPS images; and downloading soft fonts. It can put shaded bands across a page to mimic old-style computer printouts and can insert line numbers.

You can make the program read the numerical value from a field in a data file and select a different font for printing it, depending on what the program finds. You can increment values for automatic numbering of invoices or tickets.

If you want to print all the .TXT files on your disk in two columns of small type, a ten-line *PageGarden* program will do the job. If you want the page number to print over a graphic that rotates 90 degrees and prints a half-inch farther down the right margin on each new page, that takes a few more lines. You can also print text vertically, sideways, or upside-down on a LaserJet page that also includes normal text.

You can duplicate many of *PageGarden*'s functions in expensive word processors, database publishing programs, and forms software. But for repetitive printing on a laser, using *PageGarden* can be simpler and faster. ■

**List Price:** Dan Bricklin's *PageGarden*, \$99.95. **Requires:** 256K RAM, HP LaserJet Plus or compatible printer or any PostScript laser printer. (No graphics monitor required.) Software *PageGarden* Inc., P.O. Box 373, Newton Highlands, MA 02161; (617) 332-2240.

CIRCLE 439 ON READER SERVICE CARD





# No matter which of these modes you use,

40-column CGA Text  
40-column EGA Text  
40-column VGA Text  
80-column CGA Text  
80-column EGA Text  
80-column VGA Text  
Lo-res CGA Graphics  
Hi-res CGA Graphics  
MDA Monochrome Text  
80-column VGA Monochrome Text  
Lo-res MCGA Graphics  
Lo-res VGA Graphics  
Med-res VGA Graphics  
EGA Monochrome Graphics  
Hi-res EGA Graphics  
Hi-res MCGA Graphics  
Hi-res VGA Graphics

## we have the VGA display for it.



Magnavox introduces two new Professional Series displays that are fully compatible with all 17 VGA modes—both designed with the intelligence you've come to expect from Magnavox.

With a VGA display system, you'll get the most out of your present software and prepare yourself for graphics environments like Windows 386, OS/2,<sup>™</sup> and Presentation Manager.<sup>™</sup> Resolutions include 720 x

400 for text, and 640 x 480 in 256 colors for graphics.

Both displays have a 14" CRT, versus the 12" industry standard. And both come with a built-in tilt/swivel base and are backed by a 2-year limited warranty—twice as long as most other brands.

At \$229 for the 7BM749 paper-white monochrome and \$649 for the 9CM082 color display, Magnavox makes VGA displays affordable.

# MAGNAVOX

Smart. Very smart.

CIRCLE 127 ON READER SERVICE CARD

## First Looks

## TGL+ Converts Incompatible File Formats

## HANDS ON

by Robin Raskin

If you work with PC-based graphics images from a variety of sources, no doubt you'll have to deal with a slew of incompatible file formats, many in need of conversion. *The Graphics Link Plus (TGL+)* can help you with this task. Primarily a nonmemory-resident conversion program that works with all popular bitmap formats on both the PC and the Mac, *TGL+* also offers dithering, scaling, and screen-capture utilities—all of which are highly adjustable, thanks to the program's intelligent menu options.

In addition to handling such popular formats as .PCX, .TIF, .MSP, .WPG, and .GIF, the \$149 program supports a few oddballs, including a number of RIX formats, *Manuscript's* BITT, *PFS:First Publisher* files, and *Show Partner's* .GX1 (with support for .GX2 on the way). The only notable omission is support for HPGL or .PCL conversions.

The only nonbitmap format supported is .EPS. Here, TGL+ performs a one-way conversion from a black-and-white source file to a black-and-white .EPS file. .EPS images cannot be scaled, and the conversion does not include an attached bitmap.

**TGLA's** three screen-capture utilities, although not documented in the manual, are excellent. All captured screens are saved in PICTOR format. Screen captures are straightforward WYSIWYG, with no flashy options for hiding the cursor, attaching captions, or creating borders. The DOS capture files remain consistently faithful to their source image colors.

The Text screen-capture utility captures any ASCII text file and converts it to a .PCX bitmap, or lets you substitute

one of eight fonts included on-disk, saving the image as a PICTOR file.

*TGL+'s Microsoft Windows capture utility is a terrific mini-application run from within Windows. You can size an intended capture interactively and, believe it or not, it captures Windows colors accurately.*

If you routinely convert images from color to black and white, you'll be pleased with TGLt's dithering menu, which offers a choice of 11 different algorithms optimized for dot matrix or laser printers and for screen displays.

**TGL+**'s well-implemented image-scaling facilities give you another edge for DTP survival. You can scale and image uniformly or nonuniformly by using the Plus (+) and Minus (-) keys to specify incremental size changes. Better yet, you can enter a new dot-per-inch setting and see how this affects

the size of your image in inches.

There are other niceties. You can rotate an image (even one that is bigger than the screen) to three different rotations. An automatic trace feature turns a color bitmap into a closed shape monochrome bitmap. From here you can either recolor the bitmap or use it as a refined image with the vector auto-trace features in programs like *Corel Draw!* Rounding out the offerings is an excellent key-stroke-recording macro function that cries for documentation.

In fact, the program's biggest limitations are its half-complete documentation and its mandatory file-naming conven-

tions. For example, if you take a file called **BOY.PCX** and scale, dither, and convert it to EPS, you get a cryptically named file called **DLSLBOY.EPS**. Harvard Systems plans to release a more thorough manual shortly but says that these unusual filenames can be used to write abbreviated macros, so they'll stay. If you want your own classification scheme, you can use DOS's **RENAME** command. ■

**List Price:** *The Graphics Link* Plus, \$149. **Requires:** DOS 3.1 or later, graphics display adapter. Harvard Systems Corp., 1661 Lincoln Blvd., #101, Santa Monica, CA 90404; (213) 392-8441.

CIRCLE 417 ON READER SERVICE CARD



**TGL+ handles conversions to and from most popular bitmap formats on the PC and the Mac**

### 3-2-1 LiftOff: Transferable Lettering for The LaserJet

**HANDS ON**  
by Edward Mendelson

It isn't an add-in for Lotus 1-2-3, and it has nothing to do with the space shuttle. Whatever its name might suggest, DP-Tek's \$89 3-2-1 *LiftOff* is a program that uses a LaserJet, a sheet of special paper, and an ordinary roll of transparent tape to create lettering that you can transfer to almost any surface as a label or title. The quality is mixed, but nothing else offers the same features.

You begin in a WYSIWYG editing screen. You can use one of four supplied scalable fonts

in sizes from 6 to 60 points in white-on-black or black-on-white, boxed or underlined. The letters can read across, like ordinary text, or vertically, as on the spines of some books. And you can kern letter pairs and expand or compress the letters themselves.

Next, you print a trial run on ordinary paper. When you're satisfied, you print the letters on special paper supplied with the program. You get 12 sheets, enough for about 150 uses. Then you place the transparent tape (four rolls are supplied) over the letters and press it down with a burnishing tool (also supplied) until the letters are transferred from the paper to the sticky side of the tape. You lift off the tape and put it down where you want the letters.

The sticky tape stays with the letters, so you won't use this package for anything permanent or elaborate. DP-Tek's scalable

fonts are cruder than most LaserJet fonts, but nothing stops you from using 3-2-1 Lift-Off's special paper to transfer text that you print using desktop publishing or graphics packages. You can get better letters using standard press-on letters, but you won't be able to align them as precisely.

A disk with four additional fonts, including a full range of symbols, costs \$49. A package of various extra supplies, with 50 sheets of the special paper, some tape, and a burnishing tool, also sells for \$49. ■

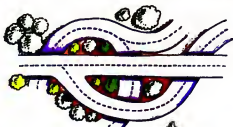
**List Price:** 3-2-1 **LitOn**, \$89; four extra fonts, \$49; extra supplies, \$49. **Requires:** 320K RAM, graphics adapter, LaserJet or compatible, hard disk, DOS 2.0 or later; mouse optional. **DP-Tek Inc.**, 3031 W. Pawnee, Wichita, KS 67213; (800) 727-3130, (318) 945-8600.

CIRCLE 444 ON READER SERVICE CARD

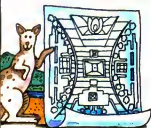
# The best reasons in the world to choose Primavera software.



**United Airlines Terminal, O'Hare Airport**  
Steel delivery problems, plus a 9-month accelerated completion deadline, put managers of United Airlines new 1.3 million-sq-ft terminal at O'Hare under the gun. Primavera Project Planner (P3) helped make the deadline.



**Port Everglades Expressway**  
The I-595 Port Everglades Expressway project involves 21 construction contracts, 8 design consultants and 93 bridges. P3 and Primavision are helping smooth the way to completion.



**Changcun Coal Mine, People's Republic of China**  
A major coal mining project, managed by the Luan Coal Industry Company, is being scheduled and controlled using Primavera software.



**Statue of Liberty Restoration & Liberty Weekend**  
It was always the "what ifs" that had planners of the Statue of Liberty Restoration worried about their ironclad July 1st deadline. There were delays and crises, but P3 enabled planners to roll with the punches. And Finest Hour tracked such oddities as moving grandstands and transporting caterers throughout the Liberty Weekend spectacular.



**Sky Dome, Toronto, Canada**  
It's the world's first stadium with a fully-retractable structural roof, and there's no "forgiveness" in the schedule. Coordinating the work of over a dozen subcontractors is the firm of Ellis-Don.



**New Parliament House, Sydney, Australia**  
Australians fully expect their new Parliament House to rival the Sydney Opera House as the architectural symbol of Australia. This showcase project is nearing completion with project management by P3.



o project managers ever chose Primavera because they liked the sound of our name. Even when it's pronounced in Swedish (Värt), French (Printemps), Chinese (普里马维拉), or Australian English (Primavera, mate!). They chose us because they know what we can do. Help them finish important projects—big and small—on time, on budget, down to the last detail.

No other software company understands project management better than Primavera. Every product we develop is dedicated to getting your jobs done faster better more easily.

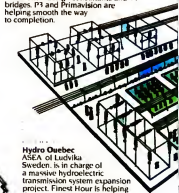
Primavera Project Planner®, Finest Hour®, Primavision™, Parade™, Expedition®, Software to schedule, allocate resources, control budgets, present information graphically, measure performance—even manage the paperwork associated with your job.

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**Hydro Quebec, ASEA of Ludvika, Sweden**  
Sweden is in charge of a massive hydroelectric transmission system expansion project. Finest Hour is helping them meet their 1994 deadline.



**Statue of Liberty Restoration & Liberty Weekend**  
It was always the "what ifs" that had planners of the Statue of Liberty Restoration worried about their ironclad July 1st deadline. There were delays and crises, but P3 enabled planners to roll with the punches. And Finest Hour tracked such oddities as moving grandstands and transporting caterers throughout the Liberty Weekend spectacular.



**Software you can count on to keep you in control.**

by  
Alan Cohen

# New & Improved

News of Announced Products and Upgrades

## New NEC MultiSyncs Offer Resolutions of Up to 1,280 by 1,024

### NEW

NEC has added to its ever-growing line of MultiSync monitors and accessories with four new products designed specifically for graphics professionals.

The \$3,699 MultiSync 5D Color Monitor, a 20-inch color model, incorporates a microprocessor-based digital control system that automatically scans the incoming video signal and adjusts the screen parameters to show the optimal image. The 5D also features a user-programmable memory and supports noninterlaced resolutions of 1,280 by 1,024, 1,024 by 768, VGA, Super VGA, and Apple Mac II, as well as 1,024 by 768 interlaced (compatible with IBM's 8514/A adapter).

A less expensive, albeit smaller, alternative to the 5D is the new MultiSync 4D Color Monitor, a 16-inch model that supports the same resolutions as the 5D except for 1,280 by 1,024. The 4D, which retails for \$1,799, features the same digital technology as the 5D and, like its bigger brother, comes complete with NEC's Multicable connection system—a single cable that can be used to connect the monitor to either IBM or Apple Macintosh computers.

NEC's third offering, the MultiSync GS2A Gray Scale Monitor, is a 14-inch unit intended for users involved with text applications and desktop publishing. Featuring a flat-screen surface, the \$349 GS2A can display unlimited shades of gray and supports both VGA and Super VGA resolutions.

The MultiSync Graphics Engine AT is a graphics adapter compatible with MultiSync monitors. Built around the Texas Instruments 50-MHz TMS 34010 chip, the board increases the processing speed of graphics-based software. Two versions are available for IBM AT and compatible computers. The 16-color model retails for \$1,499 and has 512K VRAM and 768K DRAM, while the 256-color version, which includes 1MB VRAM and 768K DRAM, lists for \$1,999. A 16-color Micro Channel board costs \$1,499. Both 16-color versions can be upgraded to 256 colors with a \$499 upgrade kit.

The MGE is designed for users who need



The screen of NEC's MultiSync 5D Color Monitor offers resolutions of up to 1,280 by 1,024 on its 20-inch (diagonal) screen.

speed, compatibility, and multitasking support to take advantage of *Windows* and presentation graphics applications.

**List Price:** MultiSync 5D Color Monitor, \$3,699; MultiSync 4D Color Monitor, \$1,799; MultiSync GS2A Gray Scale Monitor, \$349; MultiSync Graphics Engine (MGE) AT (16-color version), \$1,499; MGE AT (256-color version), \$1,999; MGE Micro Channel (16-color), \$1,499; MGE color upgrade for 16-color versions, \$499. NEC Home Electronics (USA) Inc., 1255 Michael Dr., Wood Dale, IL 60191; (312) 860-9500.

CIRCLE 432 ON READER SERVICE CARD

### HOT PROSPECT

#### VGA PRODUCER CONVERTS VGA SIGNALS TO GENLOCKED NTSC, SUPER VHS

You don't have all that many options when it comes to putting your VGA-produced graphics onto videotape, but now you have one more choice: Magni Systems' VGA Producer, a genlockable board that plugs into the full-length 8-bit slot of any AT-compatible computer and works with any VGA card that has a 28-pin socketed RAM DAC (digital-to-analog converter). All NTSC and Super VHS encoding takes place in the \$1,695 board, leaving the VGA output to your monitor unaffected, according to the company.

A remote-control unit allows for the creation and manipulation of a variety of special effects, such as keying, border color fills, x-y positioning, and timed fades between video images and graphics. All effects can be enabled in both NTSC and S-VHS modes.

**List Price:** VGA Producer, \$1,695. **Requires:** VGA board with 28-pin socketed RAM DAC. Magni Systems Inc., 9500 SW Gemini Dr., Beaverton, OR 97005; (800) 237-5964, (503) 626-8400.

CIRCLE 433 ON READER SERVICE CARD

VGA Producer works in tandem with a VGA card's RAM DAC to output composite and Super VHS signals.

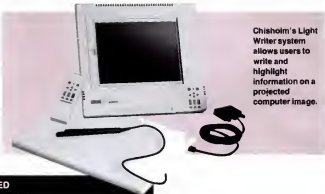


## New & Improved

### Light Writer Annotates Projected Presentations

#### NEW

LCD projection panels are nothing new. Chisholm, however, adds a new twist to an old technology. Its Light Writer tablet and electronic pen and its Looking Glass LCD projection panel, operating in tandem, function much like an electronic blackboard. You jot down notes or figures on the Light Writer tablet, which transmits the writing to the image on the Looking Glass panel. An erase but-



Chisholm's Light Writer system allows users to write and highlight information on a projected computer image.

#### IMPROVED

**ProComm Plus, LAN Version**—ProComm Plus Network Version supports asynchronous communications servers from companies such as Novell, 3Com, Gateway Communications, IBM, and Ungermann-Bass. The package features 12 error-correcting file-transfer protocols (with 2 designed specifically to accommodate high-speed error-correcting modems), 16 asynchronous terminal emulations with keyboard remapping, a fully automated dialing directory, a script command language, context-sensitive help, record (learn) mode, and host mode for remote access. The ProComm Plus Network Version, which retails for \$595, includes software for five workstations. Additional nodes can be purchased for \$79 each. Datastorm Technologies Inc., Columbia, Mo.; (314) 443-3282.

**WordPerfect, Version 5.1**—Although not as dramatic an update as Version 5.0, WordPerfect 5.1, expected to ship by the end of the year, does feature a number of important new features and enhancements. The program now provides table generation, with the ability to combine and split cells and to perform four-function math on data inside the cells. An auto-expansion feature enlarges cells as you enter data; tables can be created automatically from tabbed text, and up to 32 columns and 765 rows can be accessed in any single table. In addition, spreadsheets can be imported into any part of a WordPerfect document, including tables. Other new features include an equation editor, a mailing-label generator, pull-down menus, mouse support, dictionary-based hyphenation, and context-sensitive help. In addition, the program's Merge feature has been improved, allowing Merge commands to be used inside headers and footers, footnotes and end notes, and text boxes. Merge codes can also be hidden or revealed during normal text editing. WordPerfect, Version 5.1, will retail for \$495. Current WordPerfect users can upgrade from any previous version for \$85 (plus \$2.50 for shipping and handling). Customers who purchase Version 5.0 30 days before or 30 days after the release of Version 5.1 may receive the upgrade at no charge. WordPerfect Corp., Orem, Utah; (801) 225-5000.



WordPerfect 5.1 now offers drop-down menus in addition to the function-key operation found in previous versions.

**SPSS for OS/2**—Running under Presentation Manager, SPSS for OS/2 offers the full functionality of the SPSS statistical analysis package currently available for MS-DOS systems and mainframes. OS/2 users who do not wish to work within the PM interface can choose the traditional SPSS command-driven interface; context-sensitive help and an online statistical glossary are also provided. SPSS for OS/2 enables the user to display data in simple case listings or customized reports and supports most popular spreadsheet and

CONTINUES ON PAGE 56

ton on the pen allows the information to be deleted.

Light Writer also offers freehand drawing capabilities with a choice of four line sizes—fine, medium, thin, and paintbrush—as well as a straight-line mode. In addition, boxes can be superimposed, enlarged, reduced, and moved to highlight specific segments of a displayed image.

All Light Writer-generated information can be saved to disk by itself or in combination with the presentation graphic. The tablet measures 10 by 13 inches and connects to the Looking Glass through Chisholm's Universal Prism, an RS-232 interface that comes with Light Writer.

**List Price:** Light Writer and Looking Glass, \$3,295; upgrade to Light Writer for current Looking Glass owners, \$1,295. Chisholm, 910 Campisi Way, Campbell, CA 95008; (408) 559-1111.

CIRCLE 438 ON READER SERVICE CARD

### Express Publisher Brings Scalable Fonts To Low-End DTP

#### NEW

If you've been itching to try your hand at desktop publishing but are not so keen on writing out a hefty check for page-layout software, PowerUp! Software Corp.'s Express Publisher might be worth a look. It's not Ventura or PageMaker, but at \$149.95, it's not a mortgage payment either.

This low-end, WYSIWYG package offers a number of high-end features. Thanks to Agfa Compugraphics' Intellifont technology, the program allows font styles, attributes, and point sizes to be selected, viewed, and changed on the fly. Both CG Times and CG Triumvirate—scalable versions of Times Ro-

CONTINUES ON PAGE 56



September 26, 1989

Paradox 3.0

*"Torture testing at PC LAN Labs turned up a clear winner among the multiuser databases: Paradox 3.0"* — PC Magazine, September 26, 1989

# You win!

When we win, you win. And that's just happened again.

PC Magazine tested 6 different multiuser databases to find out how well they perform in network environments. Paradox® 3.0 was the clear winner.

And you're the clear winner because there's no confusion about which multiuser database to buy.

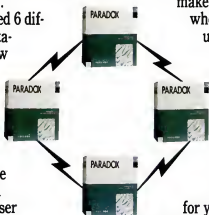
Paradox 3.0's record-locking, automatic updating, "Query-by-Example," instant graphs,

and presentation-quality graphics make you a winner—whether you're a single user or on a network.

And that's just the beginning of Paradox database power.

And you can try the winner, before you buy the winner.

Call 800-345-2888 now for your Trial Version of Paradox 3.0. For only \$9.95.



**B O R L A N D**

Code: MP97

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CIRCLE 147 ON READER SERVICE CARD



# Best Cache For Little Cash

Even if your computer has a memory cache, disk caching can double or triple your system performance for only \$79.95. Read what the editors of PC Magazine say about Multisoft's products in the February 14, 1989 issue.

**PC EDITOR'S CHOICE**

## • Super PC-Kwik

*Speed is the only reason to use a disk cache, but speed isn't the only criterion to use in choosing one. The best cache program is the one that speeds up disk activity while occupying the least DOS memory and adapting to the special requirements of your work and your computer.*

*Super PC-Kwik is the fastest cache program available, and it's also the one with the most useful and sensible options. You can squeeze it down to as little as 9K of RAM and still maintain a half-megabyte cache in expanded memory. You can also benefit from its speed and intelligence if you keep the cache in conventional or extended memory.*

*When you combine it with the RAMdisk, print spooler, and other programs in Multisoft's PC-Kwik Power Pak, Super PC-Kwik makes better use of your memory than any other cache you can buy.*

Order Super PC-Kwik today and see what the industry's best disk cache can do for you, or get the most for your money with our 5-in-1 Power Pak.

**Super PC-Kwik \$79.95**

**Power Pak \$129.95**

30-day money-back guarantee  
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Beaverton, OR 97006  
503-644-5644  
**800-283-6858**

CIRCLE 170 ON READER SERVICE CARD

## New & Improved

### Express

CONTINUED FROM PAGE 54

man and Helvetica, respectively—come with the package.

Furthermore, a Learn Style command allows Express Publisher users to create new

styles within a document by copying the style of a formatted section. In this way, settings for fonts, indentation, and justification for one specific paragraph can be named and then applied to a series of paragraphs in the document.

The package also supports most major clip-art formats, including .TIF, .PCX, .EPS, .IMG, and .ART, and import filters allow you to transfer documents from many

CONTINUES ON PAGE 59

## IMPROVED

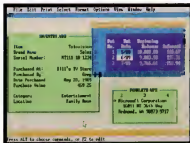
CONTINUED FROM PAGE 54

database programs, including the IBM OS/2 Extended Edition relational database. There are over 50 statistical procedures, and an advanced programming language lets the user create customized macros. Operating within the OS/2 environment, SPSS provides multitasking capability and allows the user to work with an unlimited number of variables and cases. Add-on options include SPSS Advanced Statistics, which offers procedures for nonlinear regression, discriminant analysis, loglinear analysis, multivariate analysis of variance, probit analysis, and survival analysis; SPSS Tables, which allows for the creation of a variety of stub and banner tables; and SPSS Trends, a forecasting and time-series-analysis tool. SPSS for OS/2 retails for \$995. Each add-on package is \$495. SPSS Inc., Chicago, Ill.; (312) 329-3300.

**VM/386, Version 1.22**—IGC's multitasking environment now gives users the ability to assign more than 640K of RAM to each virtual machine in a system with a monochrome, CGA, or Hercules video adapter card; it also will shadow video ROM to RAM for faster video performance. VMKEYS, a new TSR included with the package, enables users to switch among virtual machines with just one keystroke. Version 1.22 also allows for larger RAMdisks (up to 10MB) and disk caches (up to 3MB), and virtual machine performance options can be altered from the DOS command line or from within batch files. Support for the Adaptec Model 1540 SCSI disk controller and for LIM 4.0 EMS has also been added, as has support for DOS 4.0 and 4.01. In addition, the package also supports IGC's new \$150 NetPak connectivity add-on module. VM/386 1.22 retails for \$245. To upgrade from Version 1.2 costs \$50, while owners of versions before 1.2 can receive the new edition for \$100. IGC, Santa Clara, Calif.; (408) 986-8373.

**Microsoft Works, Version 2.0**—Microsoft Corp. has added a long list of new capabilities and enhancements to its Works integrated software package, including multiple windows (up to eight can be on-screen at any one time), a print-preview feature, on-screen WYSIWYG display styles (including boldface, italic, underlined, superscript, and subscript), a thesaurus and spelling checker, file-management operations, an applications launcher, a calculator, an appointment manager and alarm clock, extended memory support, footnotes, a forms generator, paragraph borders, a communications buffer, and an auto-dialer.

In addition, spreadsheet rows can be sorted and you can apply over 70 mathematical, financial, statistical, and logical functions to data in a spreadsheet. Charts can also be created from spreadsheet data. The on-line help, database reports, and file backup and conversion options have all been enhanced. Microsoft Works, Version 2.0, retails for \$149. Current owners can purchase the upgrade for \$50, and those buying Version 1.05 after October 1, 1989, can receive the upgrade free. Microsoft Works Node Packs are available for \$75 each. Microsoft Corp., Redmond, Wash.; (206) 882-8080.



Microsoft Works 2.0 lets you open and view multiple windows simultaneously.





## PC WEEK POLL: C COMPILERS

	Overall Weighted Score	Overall Reliability	Completeness of Command Descript.	Overall Performance	Completeness & Organization of Document	Document Clarity	Compiling Process Efficiency	Product Support Quality	Value Relative to Cost	Product Support Access
Turbo C 2.0 (Borland International)	81	87	79	84	77	78	86	72	70	93
C Optimizing Compiler 5.1 (Microsoft Corp.)	76	83	80	81	78	74	76	66	87	70
C++ 1.07 (Zorisch Inc.)	66	68	64	71	63	63	69	60	58	76

"Microsoft was No. 1, but they have been unseated by Borland." PC Week, May 8, 1989

## PC WEEK POLL: SOFTWARE DEBUGGERS

	Overall Weighted Score	Overall Reliability	Effective Programmer Interface	Document Clarity	Completeness of Command Descript.	Completeness & Organization of Document	Overall Performance	Integration With Programming Environment	C Compiler Compatibility	Product Support Quality	Product Support Access	Value Relative to Cost
Turbo Debugger 1.0 (Borland International)	84	89	90	81	81	81	89	88	81	73	72	93
Codeview 2.2 (Microsoft Corp.)	73	80	71	72	74	74	74	74	78	67	64	72

"Borland's Debugger outshines Microsoft's Codeview." PC Week, May 15, 1989

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Turbo C,\* the core of Turbo C Professional, was the outright winner in PC Week's Poll of Corporate Satisfaction on C compilers. Overall, Borland won with 81. Microsoft\* placed second.

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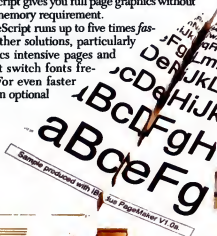
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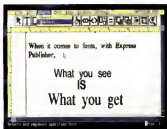
## New & Improved

### Express

CONTINUED FROM PAGE 55

popular word processing programs (including files from *Microsoft Word*, *WordPerfect*, *WordStar*, *DisplayWrite*, and ASCII). In addition, the program provides direct import and export support for *Microsoft Works*.

Editing capabilities include autohyphenation and kerning and tracking. *Express Pub-*



*Express Publisher* from PowerUp! Software Corp. brings high-end font manipulation to low-end DTP.

*lisher* can create documents of up to 32 pages and supports 300-dot-per-inch graphics and scanned pictures. Finished documents can be printed out on LaserJet, PostScript, or dot matrix printers.

**List Price:** *Express Publisher*, \$149.95.  
**Requires:** 640K RAM, hard disk, DOS 3.0 or later. Mouse recommended. *PowerUp! Software Corp.*, 2929 Campus Dr., San Mateo, CA 94403; (415) 345-5800.

CIRCLE 438 ON READER SERVICE CARD

### Identica Offers 4-mm. DAT Drive

#### NEW

The latest development in the tape backup market are the Lilliputian 4-mm. DAT cartridges, and the latest offering comes from *Identica*; the company's IDT-600 comes in both internal (\$3,895) and external (\$3,995) models and packs 600MB onto the small cassette.

The IDT-600 has a streaming speed of 5MB per minute and a transfer rate of 192K per second; it uses Advanced Reed Solomon encoding for error correction. It comes with *SY-TOS* backup software and runs under DOS, OS/2, and Xenix.

**List Price:** IDT-600, internal version, \$3,895; external version, \$3,995. *Identica*, 3300 Scott Blvd., Bldg. 7, Santa Clara, CA 95054; (408) 727-2600.

CIRCLE 437 ON READER SERVICE CARD

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- ▼ 3COM 3+
- ▼ Microsoft MS-NET
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- ▼ Ungermann-Bass Net One

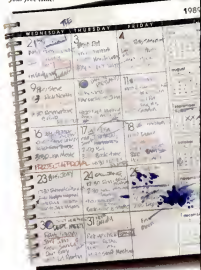
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Applied Business Technology Corporation

Hardware Requirements: IBM PC, XT, AT, PS/2 or compatible, IBM 3270 PC, DEC VAXmate  
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Many utilities thrive only on misfortune. PC Tools provides first-rate accident insurance plus much more.

Our desktop manager is one of our most noteworthy features. It has a word processor, database, addressbook, telecommunications and much more, including a calendar to help you keep appointments, print out to-do lists, even graph your free time.



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Central Point's vision is that a utility product should enhance your productivity every moment you're at the keyboard. It should simplify the way you find, preview and load a 1-2-3 spreadsheet. Make it easy to combine the contents of one document into another. Even allow you to look up a client's address while you're in the middle of another application. Everyday tasks. Tasks that, without PC Tools Deluxe, are difficult to do and take far too much time.

But it's not just what PC Tools Deluxe does that makes it different. Its windowed environment makes doing these things (as well as all of its other functions) simple. The environment's movable, resizable win-



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# n of utilities.

dows, full mouse support, pull-down menus and context sensitive help make learning and using the product a breeze. And PC Tools Deluxe conforms to IBM's Systems Application Architecture (or SAA) standards so its look and feel is almost identical to all the other applications you'll see in the 90s.

PC Tools Deluxe. It has redefined what a utility product should be. Designed not only to protect you from misfortune, but to make using your computer as fast and easy as it should be. So, even if you never have had an accident in your entire life, you'll still benefit from PC Tools the very moment you start using it.

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MI PC

CIRCLE 122 ON READER SERVICE CARD

by  
Gus Venditto

# Pipeline

A Look at the Trends Shaping the Personal Computer Market

## WordPerfect Joins Growing List of Publishers to Write Software for Windows

It's no secret that OS/2 hasn't taken the world by storm. It's starting to become clear that one reason is the burgeoning popularity that *Microsoft Windows* is enjoying. About 2,500,000 copies of *Windows* were sold by the end of 1988, excluding the several hundred

thousand free copies that were slipped into so many computer, mouse, and software boxes in recent years.

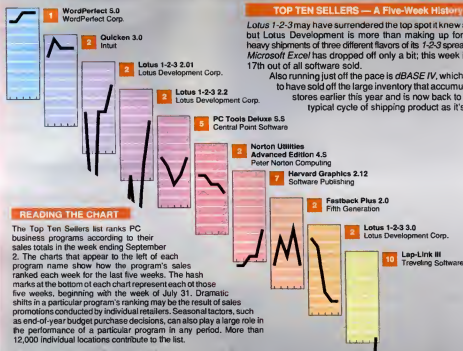
A study by Computer Intelligence of La Jolla, California, finds that purchases of *Microsoft Windows* constituted 3 percent of all PC

software sold to businesses in recent months (by unit). That may not seem like much compared with the 22 and 21 percent, respectively, that *Lotus 1-2-3* (all versions) and *WordPerfect* garnered. But that's enough to rank *Windows* among the top ten of all programs bought by businesses—higher than *dBASE IV*, *Enable*, or *Symphony*. And in the rankings of all PC software sold throughout the United States by leading distributor Ingram-Micro

D and by the top mail-order house, PC Connection, *Windows* has been consistently placing from 15th to 20th every week.

This expanding user base has convinced more software publishers to develop *Windows* versions of their programs, including *WordPerfect Corp.*, which expects to ship a *Windows* version of *WordPerfect* in mid-1990. (For a glimpse of what *WordPerfect* under *Windows* may look like, see

CONTINUES ON PAGE 64





# Pipeline

CONTINUED FROM PAGE 63

the SAA-compliant menu structure in *WordPerfect 5.1* that's previewed in this issue's New & Improved section.)

Other software publishers who have been planning to introduce new programs for OS/2 are either adding *Windows* to their plans or switching from OS/2 to *Windows*.

In fact, of all the works-in-progress that pass through *PC Magazine's* preview rooms, there's been more activity in new *Windows* programs than in any other category.

Very few of these programs will be released, however, until after Microsoft completes its next *Windows* upgrade some time before the end of the year. The next revision will employ far better memory-management and font-handling techniques and provide better responsiveness in just about every aspect of program operation. Because of this, most publishers are going

to wait until the new version's code is locked in before making announcements.

## Buy a Cause, Sell an Effect

As *Windows* and OS/2 raise the learning curve for software developers, there's a clear market for simpler application development tools—especially for nonprogrammers.

One start-up venture has come up with a cart-and-horse approach. Maxem's *Cause* is a menu-driven front end to a B-tree/ISAM database that produces executable object code. The point-and-shoot approach means anyone can slap together a working program in minutes, as easily as creating a *DataEase* or *R:base* application.

Maxem is going to sell some of these masterpieces under the brand name *Effect*. The

Tempe, Arizona-based company has set up a review board that will evaluate any user's submission; if taken on, the impromptu developer will receive royalties on sales of *Effect*.

**DCA officials divulged that the company will divest itself of its wide-area-networking division.**

## Signposts

Insiders are wondering if Novell is going to be able to keep the considerable lead it's built up among network operating systems.

Two of the company's key people in software design and marketing left suddenly this past summer, and there are no clear successors... Several years ago, DCA was on an acquisitions spree; now it's coming into shedding season. Saying that there's a decrease in the synergy among its divisions, DCA officials divulged that the company will divest itself of its wide-area-networking division... The latest trend in

shopping for cheap PCs is the TV shopping channel. IBM's close-out of the PC Convertible was one of the early experiments in selling a PC on television, and now struggling PC pioneer Kaypro expects to sell about 8,000 MC-10s on the Cable Value Network. Kaypro called its deal with CVN "the beginning of a new and ongoing relationship."

## Conferences in the South Will Rise

Atlanta has long been acknowledged as the capital of high technology for the Southeast. Now it's giving the industry its own meeting hall. InForum will be something of a combined mall and school for systems shoppers. There will be meeting rooms for conferences, showrooms where computer vendors can put their latest models on display, and classrooms for training.

The 1.5-million-square-foot building is in the heart of downtown Atlanta. The first conference was in September, and the showroom opens to the public next January. ■

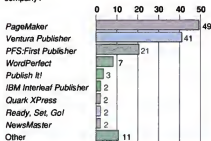


## SURVEY

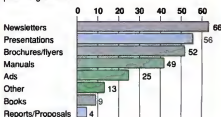
Desktop publishing software isn't as pervasive as spreadsheet and database management software, but it has become very popular in the last few years. Three out of four respondents to a survey on PC MagNet

(from a total of 898) said desktop publishing programs were being used in their offices. And about a third of those who don't use it now said they planned to install some within a year.

Which desktop publishing programs are used at your company?



Which kinds of documents are prepared with desktop publishing software?





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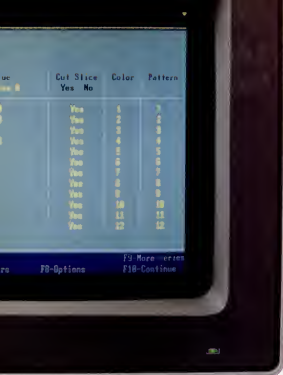


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# Bill Machrone



Some of you think  
our magazine  
should be easier  
for the beginner  
to understand.  
Here's why we talk  
the way we do.

I'm the son of first-generation Italian Americans. I, and all the children I knew, spoke only English. My parents, and everyone of their generation I knew, spoke both English and Italian. All the old people I knew spoke only Italian, with the possible exception of a few halting words of English.

From this perspective, it was clear to me that as you got older, you somehow developed the ability to speak the second language. As you continued to age, you began to lose your proficiency in English. Adults and middle-aged people were the translators, the go-betweens. In my world view, Italian was the language of elder statesmanship, the language of majority, primarily useful for discussing the things of concern to the Old Ones. It was also handy for excluding children from the things they shouldn't hear.

Then one day I met Jimmy McCoy's grandmother. She had white hair and sparkling blue eyes—and didn't speak a word of Italian. It shattered my world view.

Companies all over America reenact my familial Tower of Babel daily, as people at different levels of computer expertise battle with the near-impossibility of talking to one another. At each level, there is a common vocabulary, but the words do as much to divide people as to bring them together.

Every craft, trade, art, and occupation develops its own vernacular. The conversation of a couple of machinists would be utterly lost on a merchant seaman. Indeed, a powerboater and a sailor have relatively little in common, once you get past the basic parts of the boat and the fundamentals of navigation.

Technical topics lead naturally to jargon. The cognoscenti use it to communicate economically and accurately. They also use it to exclude outsiders. Jargon is also the key to entry. Professionals use it to recognize one another, but more importantly, they use it to discern one another's level of competence.

Computerdom doesn't offer a handy suffix like M.D. or C.L.U. to put on business cards. And even if it did, that wouldn't be much help, because most of you reading this magazine aren't in data processing anyway. Readers with MIS or data processing job titles account

for only a fifth of our total readership (though with our current circulation of over 700,000 copies, that segment of our audience is still considerably larger than the entire readership of *Computerworld*). The rest of you come from every walk of business life.

## TECHNICAL TALK

We try to make *PC Magazine* a vital part of your solution. But in so doing, we must unavoidably use jargon, technical terms, and buzzwords. Sometimes—especially when we're covering emergent technologies—we include a glossary of terms. I was reading one of our glossaries the other day and was struck by the amount of knowledge required to understand the explanations. Our definitions aren't technical out of perversity, but out of necessity.

Occasionally *PC Magazine's* technicality drives some readers to action. They write me letters asking us to run more start-up articles on such mainstream products as desktop pub-



ILLUSTRATION: ELLEN WEINSTEIN

lishing, presentation graphics, programming, and operating environments like *DESQview* and *Microsoft Windows*. Indeed, some of these letter writers are downright indignant at our lack of consideration for their plight.

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## Bill Machrone

unable to determine whether the person next to them is asking for a trowel or telling them to get out of the way. So they ask us to institute a Beginner's Kerner. They ask us to bring the articles down to their level.

## FAT CHANCE

As large as *PC Magazine* is, editorial pages are our scarcest resource. Every nontechnical page we might add would come at the cost of a page of product review or a page from one of our productivity columns. That's too big a price to pay. And *PC Magazine* won't pay it, because we understand our role. We evaluate products and enhance productivity, the editorial formula I've often described as (EP)<sup>2</sup>. We can't be all things to all people any more than a mainframe expert can also be a PC jockey.

Some of you are no doubt saying, "Hey, *PC Magazine* isn't all that technical." I agree. It's nowhere near as technical as some of the programmer-oriented journals out there. But it sure looks technical to computer newcomers. I sympathize with them. Back when I started getting interested in personal computers, the only books dealt with chips at the gate and register level. Today we have burgeoning shelves of books, both at computer stores and in the national bookstore chains.

That's the right place to go to get started. Everybody's a beginner at some aspect of computing. It's unreasonable to expect us to be there for you and 700,000 others exactly where and when you need us to be. Books give you a way to get exactly the information you need, when you need it.

Our job, by contrast, is to cover the fast-breaking information that only a periodical can give you. Remember that our marketplace is also a Tower of Babel. Compatibility, for example, is still a burning issue thanks to the infinite variety of add-on cards and peripherals that work in PCs. That, along with the subtle spin that each manufacturer puts on its compatibles, adds a high degree of interest (as in the Chinese curse, "May you live in interesting times") to our market.

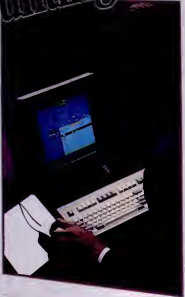

When she heard the crystal radio that my father made as a boy, my grandmother is said to have exclaimed, "Il diavolo!" She would have agreed that these are indeed interesting times. ■

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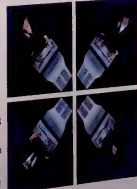
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Performance Comparisons using PC Labs Benchmark Series Release 4:

	80386 Instruction Mix	Floating Point Calculation	Conventional Memory
ZEOS 386/20 Desktop	2.87	10.40	0.39
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These are the attributes which *PC Magazine* used in awarding ZEOS the coveted Editor's Choice, not once but three times thus far in 1989. And "Overall Excellence" are the very words *PC Magazine* used in describing ZEOS systems comparing them to all others.

## Reason #2

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## Reason #8

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## Reason #10

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# John C. Dvorak



**The "replacement market" is just a myth. Old computers don't die. They just trickle down the distribution chain.**

There seems to be a wild notion floating around that the hardware business is not only going flat but is slowly turning into something new. This something is called the replacement market. Research companies, many of which can't figure out anything anyway, have dreamed up this concept in a futile effort to explain recent sales trends.

The thinking goes roughly like this: Everyone who really needs a computer already has one, and now those users are going to be spending all their time replacing worn-out old computers with new faster units. This trend will account for all of the future growth in the business.

The fly in the ointment of this theory is obvious. Computers are not tires that wear out. There is no elephants' graveyard of discarded machines, no secret dumping ground. Anyone who buys a new computer either keeps the old one, gives it to someone who can use it, or sells. This can happen over and over. Except for those that end up as "work-at-home" machines, most of these machines go to new "entry-level" owners: wives, children, fellow employees. This adds to the user base and puts more people into what I call the "trickle-down distribution chain."

Since the machines do not wear out like a set of tires, but have a life expectancy that may approach a decade or more, we should expect to see the machines distribute themselves throughout society as televisions have. Eventually, hand-me-down computers will end up in all of the 80 or 90 million households in this country, with most households having two machines. All offices will have them, all small businesses, and all schools. Every time a machine is replaced, there will be a trickle-down recipient awaiting the depreciated old unit.

To predict where computer sales will peak, we must first determine at what point we'll be able to find anyone who would refuse to accept a free machine (assuming it's a PC compatible). The number of PCs should be a good deal larger than the population of the entire country, as some people will require multiple machines. Watching the United States eventually soak up 300 million computers is not beyond the realm of possibility. We see how TV sets have been soaked up (I'm not the only

one who has a TV in the kitchen!). We can expect computers to follow the same pattern.

## NOT YET TAPPED

With today's installed base of between 26 and 30 million machines, the market hasn't even been dented. Thus, all the talk of a so-called replacement market is nonsense. In fact, the only way such a market will ever develop is if legislation prevents people from using old technology. "OK, buddy, do you have a license for that 4.77-MHz 8088?" "But officer, it has a turbo card in it!" People are still using CP/M machines and Tandy 100 portables. If they ever give them up at all, they'll give them to their kids.

While we do see jogs in the growth curve for the PC market, they're all traceable to the herky-jerky forward motion of hardware and software technology. We'll always see a temporary slowdown during a changeover from one chip to another. This is what we are beginning to see today as the 486 makes its way into



our lives. Everything slows down to wait for a realignment of prices. Once that happens there's a mad scramble, business booms, and a bunch of machines are distributed through the trickle-down distribution chain.

When we look at the scene objectively, we see that we are still closer to the beginning of the market's maturation than the end. If we're on a 100-mile trek, I figure we've gone 10 miles. Maybe less.



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# Inside Track

The industry is abuzz over what now appears to be **troublesome delays** in the full-tilt go-for-broke manufacture of the 486 chip. Both the 486 and the EISA bus are following the acceptance pattern of *Windows*, with early enthusiasm followed by delays.

This might develop into a **problem** for both technologies. Unfortunately, as in football, where the **mysterious phenomenon** called "momentum" goes from one team to another, consumer interest is fleeting. While the customer will go along with a preannouncement and maintain an enthusiastic anticipatory level for perhaps 6 months, that person cannot maintain it forever. When the momentum goes away from the original direction of enthusiasm, one sees what I call the "product acceptance backlash effect." This actually creates a **negative receptivity** on the part of a potential buyer who feels that he or she has been strung along and made a fool of. The **subconscious mind** then wants to reject the product.

I always wonder how many copies of *VISION* were ever shipped. Yes, Mildred, there was finally a product, after much hoopla and a long no-show. *Microsoft Windows* is still coming out of the backlash effect. The company even did a *Windows* "celebrity roast" a few years back to chide itself for tardiness. That was a gallant try but it had little effect.

This effect doesn't have to be solely the result of a late product introduction. In the case of OS/2, it's the result of a **lack of promised applications**. This disappointment is combined with a lack of perceived performance benefits. Whereas people can buy a 386 to run their old DOS applications and see immediate **improved performance**, the OS/2 buyer sees no improvement.

In the case of *Windows*, one might see a decrease in performance. My best joke recently on PC MagNet was "I use *Windows* when I want to slow down my programs so I can see what's happening on timed screens that blow by my 386 screamer. *Windows* gives me the XT-level performance I sometimes have to have. Very useful." It seems unlikely that most users, when given a choice between high performance with straight DOS and poor performance with *Windows*, would choose the latter, especially since most of the time one spends on a machine is within an application, and that's where performance counts. You don't think there is a line around the block awaiting the 486 machines just because the chip is **pretty**, do you? But I digress.

**Back to the acceptance backlash effect.** While pundits and cynics wisely push users into the 386 camp and beyond, the 286 sales figures continue to increase. This chip, which

has been declared **brain-dead** by everybody under the sun, sells like hotcakes because (1) it's cheap, (2) it has more than one manufacturer licensed to make it, and (3) it never experienced an acceptance backlash. This combination is hard to beat.

The 486 costs about \$500 to \$800 for the **bare chip** alone. There is only one manufacturer, and Intel shows no sign of letting anyone second-source the chip. I figure that if it doesn't ship in quantities by January, then Intel risks adding the backlash effect to the chip. Now, I wonder, if NEC suddenly released an **inexpensive 386/486 equivalent** running at 50 MHz, what would happen to Intel's **hammerlock** on the PC world?

**Don't Try This at Home, Kids Dept.:** I've been meaning to pass this tip along to people who have machines from which other people might surreptitiously **bootleg** a copy of this or that software. Most software nowadays asks you, on first use, to put your name and (optionally) your company name on it. This should **annoy** users. Who needs *your* name showing up on Bob's computer at his home? So for "name" I routinely type "All Mankind" and for "company" I put "The Whole World Over." There is something humorous about software that boots with the message: "Licensed to All Mankind, The Whole World Over."

**Genuinely Interesting Software Dept.:** I've always been a big fan of *Super PC-Kwik*, the **definitive** disk cache software from Multisoft Corp. in Beaverton, Oregon (phone (503) 644-5644). For \$129.95, it now comes bundled with what the company calls a Power Pak, which includes a print spooler, a dynamic RAMdisk, a keyboard accelerator, and a **remarkable** screen accelerator that is unlike anything I've ever seen. Apparently it does more than shadow the video ROM into RAM. It replaces the entire video BIOS with **high-performance** routines.

On my 386, video benchmark tests show a 300 percent speed improvement, and I'm running an already **hot** Video Seven V-RAM card! Believe me, the benchmark wasn't faked out. When you type DIR the listing **blows** the top off the monitor! I'm impressed. And since some programs such as *Lotus 1-2-3* do strange things with video, this software is smart enough to ignore such programs and not accelerate them. That's how well-written this little program is. In addition, it establishes a scroll-back buffer so you can back the screen up and look at the previous pages that ran off the top of the screen. **Hot stuff.**

It works with all EGA and VGA cards as well as old CGA and even monochrome beasts. The performance increase varies, depending on the card. For VGA cards, it's **dramatic**. Highly recommended. ■

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when I want  
to slow down on  
timed screens  
that blow by my  
386 screamer.

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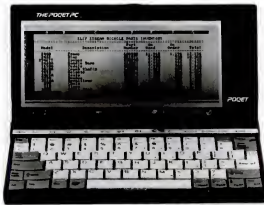
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PC Dos  
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Explored

PROCESSORS 129-59

## HARDWARE PRODUCTS

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# Jim Seymour



**Times are  
changing in the  
retail side of  
our industry.  
And the strategies  
for success  
in the 1990s  
are starting to  
come into focus.**

In the September 12, 1989, issue, each of *PC Magazine's* columnists wrote about our experiences with computer resellers and offered our prescriptions for curing what ails them.

Fixing what's wrong with the present system is important. Uninformed salespeople, scanty software inventories, and a lack of after-sales support are deadly sins, frustrating and unnecessary.

But at least as important as fixing what we have now is trying to figure out how the computer-reselling situation is going to look over the next decade. I'm convinced it won't look much like today's system—and not only because today's problems will be fixed.

We're moving into an era of fundamentally different kinds of PC products, with consequent changes in how those products are selected, purchased, and supported. And those changes will be most visible, I'm convinced, in a powerful four-way division of the computer market. Part of this trend is beginning to become visible, but when it really hits, it's going to sweep aside huge chunks of the present PC distribution system.

Department stores, electronics discounters, and "superstores" will pick up most of the business on the lower part of the scale. They're already doing well with Epson Apexes, Vendex Headstarts, Amstrads, and so on. We'll see more of these consumer-oriented lines as the technology moves away from the 8088 toward the 80286. Indeed, this market offers the only future for the 80286 chip, which would otherwise sink even sooner into well-deserved obscurity.

The middle to upper end of the market will increasingly be dominated by three groups. First, the more-powerful mail-order firms—47th Street Computer, Dell Computer, PC Connection, and CompuAdd, for example. Second, the large, well-financed, upper-end retail chains—Businessland and MicroAge, for example—that can afford to offer serious training to their staffs and maintain selective inventories for special markets. And third—the real kicker—an emerging class of large-scale specialty dealers aimed squarely at the corporate market. Eli Hertz's corporate-PC-sales operation in New York City and Mort Rosenthal's

powerhouse Corporate Software are stellar examples of the latter.

## WHAT'S WRONG WITH THIS PICTURE?

Notice who's missing? It's the middle-of-the-road, middle-market dealers and chains. And you and me, when we want to go down to the corner computer store, kick tires, check out a new program we've heard about, and schmooze a little about PCs in general.

It's not that this fourth group won't be around, or that they won't have anything to sell. They'll still have their IBM and Compaq and Apple and HP dealerships, and many of them will still be in business.

It's just that they won't be very important anymore.

The real growth, I'm convinced, will be divided between the new class of super-resellers, such as Corporate Software, and the biggest mail-order firms, which through their expertise, financial strength, and focus will



ILLUSTRATION: ELLEN WEINSTEIN

come to dominate the richest part of the PC marketplace: the corporate market.

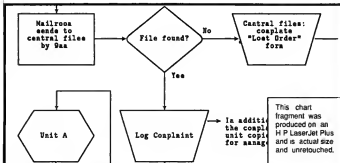
Mort Rosenthal has a little dog-and-pony speech he likes to trot around to industry gatherings, suppliers, and large customers, in which he makes some perceptive points about today's changing distribution system.

Mort's analogy for the evolution of the overall corporate computer market is superb.



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## Jim Seymour

He points out that we have seen it swing, pendulumlike, from one extreme—in the highly centralized MIS era of the 1970s—to another, highly personalized extreme—in the single-user-focused 1980s—back toward a more stable middle position, centered around networked workstations and servers, with an emphasis on departmental use and peaceful coexistence with MIS.

The distribution channels have followed those swings, moving from direct sales and support by vendors in the '70s to sales and support through retailers in the '80s, toward whatever may emerge in the integrated environment of the '90s.

### THE SHAPE OF THINGS TO COME

Unsurprisingly, Mori thinks the '90s are made to order for a shop like Corporate Software—and I think he's right. Many of the largest PC vendors never established the close customer ties that might have permitted them to move now to a '70s-like direct-selling situation.

Those relationships count.

That's one reason I think good direct-marketers have such bright prospects for the '90s. They've created and maintained those personal links, through fast service at the time of the sale and through superb 800-line after-sales support.

And that's just what Corporate Software has done, by mixing field-sales people into what is fundamentally a direct-sales system.

The corporate micro managers who have relied on Corporate Software to take some of the pain out of software upgrades demonstrate how much this marketplace wants the new kind of reseller. By offering almost-as-low-as-the-lowest prices in conjunction with advice, product savvy, and great support, Rosenthal has built the kind of company few realized would be needed in the 1990s.

The center of gravity of the PC market lies overwhelmingly in high-volume corporate sales. But that doesn't mean you and I will be frozen out, left playing *King's Quest XXVII* down at a lonely, drafty ComputerLand.

The flexibility of the mail-order shops means they'll be the channel of choice for individuals, at least for most purchases. When we really need hand-holding and tire-kicking, we'll pay for it, down at the Businesslands and MicroAges. ■



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# William F. Zachmann



**The most  
profound influence  
on the future  
of our industry  
is the effect  
of past habits.**

The great American psychologist William James considered habit to be such an important phenomenon that he devoted an entire chapter of his book *Psychology* to the topic. In it, he wrote: "We must make automatic and habitual, as early as possible, as many useful actions as we can, and guard against the growing into ways that are likely to be disadvantageous to us, as we should guard against the plague."

James recognized the dual character of habit. Habit lets us do more things, by doing them automatically. But habit can also hold us captive to old ways when better opportunities present themselves.

As in other areas of human activity, habit is a powerful factor in our use of computers. The habits we form in using a particular spreadsheet, word processor, or communications package exert a profoundly conservative influence on our future choices, and so upon the course of the computer industry as a whole.

There may be a few users who always seek something new and different and who are constantly replacing one software product with another. But most of us aren't very quick to change, once we've found a product that does the job for us. It is for this reason that minor incremental improvements are seldom sufficient for one product to displace another in the software marketplace. It is only when a major advantage can be gained by switching that the superior product has a real chance to succeed.

My own use of software offers a good example. Unlike most people, I constantly review new products, not only on PCs but on the Apple Macintosh and other platforms as well. But the software that I use to do my work shows the profound effects of habit. Even though I have an unusually large number of opportunities to do so, I don't switch from one product to another for my real work any more often than other, more typical users do.

Writing and communicating are the two things I most frequently do with computers, so word processing and communications are the two most important applications in my work. When I bought my first IBM PC, in 1982, I bought both types of software. Unfortunately, both the word processor (I think it was called *Easywriter*, but I don't even remember any-

more) and the communications package (the infamous *IBM Asynchronous Communications* software) that I bought with this first system were barely usable, so I never got into the habit of using them.

## A PERSONAL HISTORY

Instead, I moved to *Smartcom* for communications and to *MultiMate* for word processing. I'd been using a Wang word processor at work, so my familiarity with it made *MultiMate* a plausible choice, much as IBM's *DisplayWrite* software appealed to those who'd previously used an IBM *DisplayWriter* and *XyWrite* appealed to journalists with experience on *Atex* typesetting systems.

It was only after writing a draft of a book with *MultiMate* and suffering through endless lengthy repaginations on my dual-floppy PC that I decided, first, that it was time to get a hard disk and, second, that I'd need to take a more serious look at other word processing



ILLUSTRATION: ELLEN WEINSTEIN

packages. I considered *WordStar* but, before long, switched to *WordPerfect*.

What a relief it was not to have to worry about whether I was at the end of a page or not! That, in the end, was what it took to break me of the *MultiMate* habit. It was only at this point that I finally dropped the Wang entirely and started to do all my writing on a personal computer. Before that, I still used the Wang at the office in order to do my research publica-

## William F. Zachmann

tions. It took *WordPerfect* on an AT-class PC to finally outmatch the old Wang system in every way.

Meanwhile, I started using an Apple Macintosh. Having already formed the DOS habit, I never did move to the Mac as my mainstream system. Still, my Mac ex-

perience encouraged me to look at *Microsoft Word*. I liked being able to use a mouse for cursor control, but *Word* was too slow for my taste, and it didn't support my printers. I also found the command structure in *Word*'s earlier versions to be too weird and unintuitive.

But the combination of a faster 386 system and the improvements in *Word* versions 3.0 and 4.0 were enough, finally, to tip the scales in favor of *Word*. Not only

the mouse, but the ability to see italics directly on the screen in graphics mode gave me enough of a reason to switch.

I've started using Samna Corp.'s *Ami* for *Microsoft Windows* for some applications. I especially like it for preparing presentation foils. But well-established habit keeps me faithful to *Word* for most of what I do. I've just installed Version 5.0, and I'm not likely to switch to another product anytime soon.

My experience shows clearly how habit acts as a stabilizing influence on software choices. But it also shows that we do change our habits when there is sufficient reason to change. With the growing maturity of OS/2 and Presentation Manager, an expanding list of great new software products that take advantage of the new environment, and lower prices for memory and for the powerful systems capable of supporting it, both the opportunities to change old habits and the reasons to do so are becoming more numerous.

The result is likely to be a more volatile market for personal computer software in 1990 than we have seen for some time. Established vendors like Lotus will be working very hard to hang on to their traditional market share with products like 1-2-3 for *PM*. Newer vendors will be entering the market with products for *Windows* and the OS/2 Presentation Manager. And Microsoft, of course, will continue to press hard to own a bigger share of the applications market.

As users, our choices will necessarily require a balance between the comfortable familiarity of established software and the promise of greater productivity and a wider range of options that new software offers.

As software environments are poised for major changes, we would do well to heed William James's advice: "Keep the faculty of effort alive by a little gratuitous exercise every day. That is, be systematically ascetic or heroic in little unnecessary points, do every day or two something for no other reason than that you would rather not do it, so that when the hour of dire need draws nigh, it may find you not unnerved and untrained to stand the test."

What better way to do this than to make an effort to try out new software and new software environments that we presently think we don't really need. We may well find that the rewards of changing old software habits are really much greater than they appear.

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September 12, 1989 Issue



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Laptop 20 M8	\$2350
Other Models	Call
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50	\$359
60	\$299
85	Call
150	\$275

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Other Models	\$319	Okidata		Other Micronics	Call
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### PLOTTERS

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DMP52	\$2439
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Lotus 1, 2, 3 LAN	1579
MS Word Network Node	119
Multimate Adv II LAN	735
Multimate Adv II Add'l User	75
Paradox Network	614

PFS Professional Network	259
Q&A Network Node	175
RBase for DOS (1-6) Network	617
RBase for DOS Unlimited	1774
Supercalc 5 LAN (requires Supercalc 5)	295
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AMI	\$119
DAC Easy Word	37
Gen 1st Word +	53
Grandview	175
Multimate Advantage II	275
PFS Office Writer	90
O & A Write	115
Right Writer	45
Sprint	39
Drp Plus	124
Drp Total Word	249
Volkswinter 4	99
Volkswinter Deluxe Plus	59
Word (Microsoft)	Call
Word Perfect 5.0	215
Word Perfect Executive	117
Word Perfect Library	58
Word Perfect Office	235
Wordstar Pro Pack 5.5	295
Wordstar 2000 Plus 3.0	248
Wordstar 2000 + Legal	315
XY Write III +	199

### NETWORKING

Novell	96
ANW/286 2.15	\$1995
SFT NW/286 2.15	2885
ELS II 2.1	1015
ELS I 2.0A	445
All Others	Call

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Summasketch 12 x 18	578

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### DOS

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### MICE

MS Bus/Serial Mouse 1 D	\$97
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PC Paintbrush +	79
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Pozzaz	42
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Ventura Publishing	499
Ventura Publishing Pro	345
VP Graphics	96
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### SR SOFTWARE TRAINING

First Choice	Call
First Graphics	Call
First Publisher	Call
Harvard Graphics	Call
Harvard Project Mgr. III	Call
Office Writer	Call
Professional File	Call
Professional Plan	Call
Professional Write	Call

### GAMES

680 Attack Sub	331
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### DISKETTES

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3 1/2 High Density (100)	59
5 1/4 DS/100 (100)	111
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# QUALITY BY DESIGN



## GV286/120

- 80286 running at 12 MHz zero wait state
- Proprietary, 32KB on-board RAM cache circuit using high speed (35ns) static RAM
- 640KB RAM, expandable to 1MB on motherboard
- Socketed for 8MHz 80287 math coprocessor
- 5.25" 1.2MB or 3.5" 1.44MB floppy drive
- Western Digital 1:1 interleave dual controller
- Enhanced 101-key keyboard
- Graphics adaptor features a full 256K of video RAM and 16-bit interface for full VGA capabilities
- 200-watt power supply
- 2 serial/1 parallel port standard (on add-in card)
- ROM based set-up and diagnostics
- Motherboard designed and manufactured in the U.S.A.
- Toll-free technical support
- One-year factory warranty, parts and labor. Overnight parts replacement available.



### OPTIONS

- RAM upgrades
- Intel 80287 math coprocessor
- On-site service agreement
- MS-DOS 3.3 or 4.01
- 256 Video upgrade \$99



## GV286/20

- Choice of slimline or Baby "AT" desktop, space-saving footprints available
- Top performance at lower cost
- VLSI technology for increased reliability
- 80286 running at 20 MHz zero wait state
- Paged-Interleave Memory Architecture
- 1MB RAM standard, expandable to 2MB or 4MB configurations on motherboard
- Socketed for 10MHz 80287 math coprocessor
- 5.25" 1.2MB or 3.5" 1.44MB floppy drive
- Western Digital 1:1 interleave dual controller
- Enhanced 101-key keyboard
- Graphics adaptor features a full 256K of video RAM and 16-bit interface for full VGA capabilities
- 200-watt power supply
- 2 serial/1 parallel port standard (on add-in card)
- ROM based set-up and diagnostics
- Motherboard designed and manufactured in U.S.A.
- Toll-free technical support
- One-year factory warranty, parts and labor. Overnight parts replacement available

### OPTIONS

- RAM upgrades
- Intel 80287 math coprocessor
- On-site service agreement
- MS-DOS 3.3 or 4.01
- 256 Video upgrade \$99



## GV386/20 PLUS

- 80386 running at 20 MHz zero wait state
- 1MB RAM on motherboard
- System is capable of expanding to 16 MB of 32-bit RAM
- Proprietary, 64KB on-board RAM cache circuit using high speed (35ns) static RAM
- Socketed for 20MHz Intel 80387, or 20MHz Vitek 3167 math coprocessors
- 5.25" 1.2MB or 3.5" 1.44MB floppy drive
- Western Digital 1:1 interleave dual controller
- 2, 8-bit, 4, 16-bit and 2, 32-bit memory expansion slots
- Graphics adaptor features a full 256K of video RAM and 16-bit interface for full VGA capabilities
- 2 serial/1 parallel port standard (on add-in card)
- ROM based set-up and diagnostics
- Motherboard designed and manufactured in U.S.A.
- Toll-free technical support
- One-year factory warranty, parts and labor. Overnight parts replacement available

### OPTIONS

- RAM upgrade to 3 MB add \$725 to 5 MB add \$950
- 20MHz Intel 80387 and 20MHz Vitek 3167 math coprocessors
- On-site service agreement
- MS-DOS 3.3 or 4.01
- 256 Video upgrade \$99



## GV386SX

- Run 32-bit operating systems, applications software, or Windows 386 at a lower cost
- Slim-line, space-saving desktop configuration
- 80386SX running at 16 MHz zero wait state
- 2MB RAM standard, 4MB capacity on motherboard
- Socketed for 16MHz Intel 80387SX, math coprocessor
- 3.5" 1.44MB floppy drive
- Western Digital 1:1 interleave dual controller
- VLSI technology for increased reliability
- Graphics adaptor features a full 256K of video RAM and 16-bit interface for full VGA capabilities
- 2 serial/1 parallel port standard (on add-in card)
- ROM based set-up and diagnostics
- Motherboard designed and manufactured in U.S.A.
- Toll-free technical support
- One-year factory warranty, parts and labor. Overnight parts replacement available

### OPTIONS

- RAM upgrade to 4MB add \$300
- 16 MHz Intel 80387SX math coprocessors
- On-site service agreement
- MS-DOS 3.3 or 4.01
- 256 Video upgrade \$99

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44MB, 23ms, ST506	\$2,149	\$2,499
71MB, 27ms, ST506	\$2,409	\$2,769
150MB, 18ms, ESDI	\$3,299	\$3,599
320MB, 18ms, ESDI	\$4,099	\$4,399

NEW PRICES	VGA Mono	Extended VGA Color
44MB, 23ms, ST506	\$2,895	\$3,095
90MB, 18ms, ESDI	\$3,395	\$3,795
150MB, 18ms, ESDI	\$3,995	\$4,395

NEW PRICES	VGA Mono	Extended VGA Color
44MB, 23ms, ST506	\$3,399	\$3,699
71MB, 27ms, ST506	\$3,659	\$3,959
150MB, 18ms, ESDI	\$4,399	\$4,799
320MB, 18ms, ESDI	\$5,199	\$5,599

NEW PRICES	VGA Mono	Extended VGA Color
44MB, 23ms, ST506	\$2,795	\$3,195
90MB, 18ms, ESDI	\$3,495	\$3,895

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# Stephen Manes



**Pity the life of the  
columnist: one ear  
to the phone,  
the other to error  
beeps, he endures  
flaky disks,  
silly installation  
programs,  
and ignorant  
publicists—and all  
just for you.**

My other reader writes that he is considering a career in computer journalism because it seems so easy. Before he takes the plunge, however, he would like to know what exactly a respected columnist does all day.

I, of course, have no idea whatsoever what *respected* columnists do. But I do have the next best thing: a log of a typical day here at the Manes Column Factory.

8:00 A.M. Column deadline tomorrow A.M. Idea needed. Quaff caffeine. Scan dailies for hot computer scoops. Only news: depressing quarterly earnings report at Ganef Software. Last-resort game plan for column: actually try new products.

8:13 A.M. Try to check e-mail. 2,400-bps modem dead. Attempt to revive.

9:22 A.M. Give up. Replace modem with 1,200-bps model from closet. Dig up 1,200-bps phone numbers. Rewrite log-on scripts.

10:15 A.M. Check electronic mailbox. Delete junk press releases. Attempt to decipher incomprehensible natterings of "fan" apparently under influence of nitrous oxide. Devise tart replies to other correspondence.

10:36 A.M. Sign on to PC MagNet. Swipe niftiest "on-liners" for possible future use.

11:01 A.M. Tackle software backlog using time-honored "oddest first" principle. Goofy and thus potentially interesting *HelpsUThink* package at top of pile comes compressed on seven high-density disks, requires 15MB of hard disk space, warns installation may take 40 minutes. What the hey; it's still morning.

11:06 A.M. Protect cherished CONFIG.SYS and AUTOEXEC.BAT from near-certain destruction by swapping them with benign plain-vanilla versions. Reboot.

11:09 A.M. Begin installation. Discover program doesn't beep when disk-swapping required. Stare blankly at screen messages; contemplate advantages of multitasking.

11:28 A.M. Answer phone. California publicist touts hot new software, is shocked to learn that *PC Magazine* does not generally cover Atari ST products.

11:35 A.M. Installation process drags on. Answer doorbell. UPS deliverer has left four valuable surprise packages on porch.

11:38 A.M. Return to machine. *HelpsUThink*

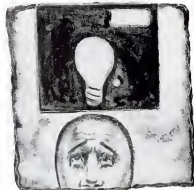
Installation Disk 9 produces "Disk Read Error." Mutter oath. Repeat disk access attempts. Reread redisplayed error messages. Mutter many oaths. Abort process, realize full reinstallation will be required. Mutter many vehement oaths. Note disk lacks hub ring, tacky omission last seen in glory days of CP/M.

11:44 A.M. Phone *HelpsUThink* vendor. Vendor brilliantly diagnoses problem as "bad disk," promises Fed-Ex'ed replacement.

## PLASTIC PEANUTS

11:50 A.M. Open UPS loot: elephantine volumes of plastic peanuts, elephantine manuals, folders stuffed with press releases, actual products. Products prove to be: Yet Another Database, *Chex Your Text*, Weekly Update (Version 37.0) of Ho-Hum Bulletin Board System, and *DOS Basics for Clambrains*. File all but *Chex Your Text* on "Unlikely" shelf.

12:20 P.M. Answer phone. PR guy returns call from 3 weeks ago regarding genuinely



interesting forthcoming "breakthrough" hardware product. Because of my unique position in industry, promises to put me on list for evaluation copy in early 1992, after columnist for *Microsurgery* but before columnist for *Silicon Groul News*.

12:42 P.M. Error messages from *Chex Your Text* installation program reveal it wants disk to be in drive A: Manual fails to offer origami technique for fitting supplied 5.25-inch disks

## Stephen Manes

in 3.5-inch drive. Consider running *DOS Basics for Clambrains* to find explanation of ever-forgettable difference between ASSIGN and SUBST. Reconsider after reading Clambrained installation instructions.

12:54 P.M. Fax machine rings. Completely illegible fax arrives.

12:57 P.M. Copy all files from *Chex Your Text* to hard disk.

1:01 P.M. Phone rings. Computer journalist/friend asks how fax looked. Disappointed at failure of new hush-hush top-secret PC-to-fax software.

### CRISIS OF CONFIDENCE

1:13 P.M. *Chex Your Text* runs. Confidence level nears absolute zero when opening screen displays message "Loading wordlist with synonymous" (meaning "synonyms").

1:47 P.M. Beautiful fax photo of friend's 2-year-old arrives.

1:49 P.M. Phone rings. Journalist/friend asks how fax came out this time. No

chuckle at jape re daughter's looks.

1:53 P.M. Postal Servant arrives. Mail includes \$0.00 invoice from Mollusk Development with scrawled message "We claim you'll love it!" two bent and folded floppy disks in "do not bend or fold" mailers, one dozen computer publications, a dollar-rebate offer from Instant Pizza, a bill from long-canceled Tragedy On-line Service, an offer to subscribe to Tragedy On-line Service, and three pounds of press releases. Carefully file pizza coupon. Pitch invoice, bill, offer, disks. Pitch all accounting, network, micro-to-mainframe, career opportunity, and special seminar press releases without opening. Open remainder, scan carefully for telltale deep-six phrase "was appointed to."

1:56 P.M. Mail pile now down to manageable two dozen items. Read opening paragraphs of remaining releases, carefully file under "recycling."

2:08 P.M. Lunch. Skim trade journals for hot trends.

3:41 P.M. Finish skim. No hot trends today. Invoke Discus, the muse of the computer column deadline.

3:50 P.M. An idea will turn up. It just has to.

3:51 P.M. Fed Ex guy turns up with war-game software press release. Package includes plastic popcorn, broken toy tank, fake draft notice, vaguely lewd coffee mug. Program disk is absent.

3:58 P.M. Phone rings. Friend's hard-disk defrager just declared itself unable to write File Allocation Table back to hard disk. Disk, she no work no more. Good news: before running DOS, friend backed up disk. Bad news: only copy of DOS version used for backup was on that disk. Tell friend not to panic.

4:07 P.M. Arrive at friend's house. Begin reformatting hard disk. Remind friend of past warning that products that mess with disks invariably waste more time than they save.

5:47 P.M. Restoration complete. Disk good as new. Friend offers beer as compensation. Compensation accepted.

7:00 P.M. Eat leisurely dinner.

7:02 P.M. Attempt to install vaguely interesting 12MB program.

8:30 P.M. Vaguely interesting 12MB program refuses to run.

8:31 P.M. Disconnect phone, fax.

8:40 P.M. Clarity! Ideas! It really is easy, isn't it?

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# THE 1989 PRINTER ROUNDUP

●

PC Labs tests  
109 new printers for our  
sixth annual  
printer roundup, the biggest  
in 5 years.

●

*by John Dickinson*

You might ask yourself why, after 5 consecutive years of producing the PC industry's only comprehensive printer guides, *PC Magazine* is doing it again. You may also wonder why comprehensive tests and reviews of 483 printers in past years weren't enough, and why 109 more printer reviews are needed now.

The most obvious answer is that the PC industry has coughed up yet another 109 new printers this year, making the sixth annual printer roundup the largest in five years. And, just like lemmings that can't help but walk into the sea, *PC Magazine's* intrepid crew of editors and reviewers feels a need to traipse into this torrent of new printers, test and review them, and tell you which of these new printers offer the best way for you to get your printing job done.

The annual printer roundup, now in its sixth year, always begins with a period of self-examination at PC Labs. Never content to rest on our laurels, we stand back and take a good long look at our own testing process to determine what should change and what should stay the same.

This year, we began examining our tests back in April, when project leaders, editors, and printer project veterans got together to devise tests that would best measure the current batch of printing wonderkids. Our efforts yielded a suite of tests that occupies almost 30MB of hard disk space and includes enhanced tests for HP PCL and PostScript compatibilities, as well as new graphics output—including color—and graphics speed tests. Our text speed test has remained untouched, allowing you to compare text-speed results among the nearly 600 printers *PC Magazine* has reviewed since 1984.

#### THE SPEED OF TEXT

The methodology we employ to measure a printer's text speed differs considerably from the one used by printer vendors. Manufacturers rate their printers' *burst speeds*—the speed at which a machine sends a single block or line of characters. At PC Labs, we use a real-world test: a two-page business letter in single-spaced format, known around here as the Arthur D. Author test. Since we run every test at least twice, the score we print is the average result. In The PC Magazine Printer Guides,

#### SHARING A HUGE PIE

But that begs the question of why so many new printers have been manufactured by so many vendors this year. You might think that in this tough, competitive business, fraught as it is with high technology and high finance, the answer would be difficult to discern. But, in fact, it's quite simple: Opportunity. Spell that d-o-l-l-a-r-s.

InfoCorp estimates that the domestic PC printer market for business users is quickly rushing toward peak annual sales of nearly 6 million units and \$4 billion. After that peak is reached, either this year or next, the printer business will fall off a bit but will still generate revenues of well over \$3.5 billion. If you toss in the government,

home, and education markets, you add another \$1 billion to the heap, and that's not counting printers sold outside the U.S.

These are big numbers: the estimated \$5 billion 1990 printer market is equivalent to roughly 10 percent of the entire PC industry. These big numbers mean that printer vendors don't need a lot of market share to make money, or at least to generate a nice-size pile of revenue. For example, a tiny 2 percent share of this \$5 billion PC subindustry yields \$100 million in revenue. That's a size that many successful small businesses would look upon with a great deal of envy. For that matter, so would a lot of PC software and peripheral companies that you and I consider solid enough to do serious business with.

For you, these big numbers mean

## HOW WE TESTED THE PRINTERS

by Bill O'Brien

you'll see the results of our speed tests expressed in numbers and bars, allowing you to compare printers within each category at a glance. For both text and graphics speed tests, the longer the bar, the faster the printer.

For laser printers, we print ten copies of Arthur D. Author—to minimize the normal time-to-first-page disadvantage. Since 1986, we've measured the speed of laser printers in pages per minute (ppm), which is calculated by the 80286-based PC sending the test. This year's crop of lasers ranged from 4 to 22 ppm in the manufacturers' rated speeds and from 3.9 to 21.5 ppm in our tests. As a point of reference, consider that Hewlett-Packard's LaserJet Series II, which is rated at 8 ppm, scored 7.5 ppm on our tests (in our printer issue of November 10, 1987).

For dot matrix printers, a single copy of Arthur D. Author is printed, and the speed is measured in characters per second (cps). We've included each dot matrix printer's best-quality text speed—as well as its default text speed—in the Printer Guides. To judge how well a dot matrix printer scored, compare its rated speed with our test result: we expect about half its claimed

speed in draft mode, and one quarter of its claimed speed in letter quality or near letter quality. In draft mode, the narrow-carriage IBM Proprinter X24E and its wide-carriage XL24E sibling (both reviewed in this issue) scored 99 cps and 159 cps, respectively, on our tests.

#### 4 ppm = 266 cps, SORT OF

If you're trying to choose between a high-end dot matrix and a low-end laser, you may be wondering how to convert ppm to cps—a tricky task that's been debated hotly in our hallowed halls. The problem is that this kind of conversion is inherently unfair to laser printers, which print every page—however small or large the file—at the same speed.

Among the printers reviewed in this issue, the one that really begs the question is Hewlett-Packard's new LaserJet Series IIP. With a street price of around \$1,200 (including the optional paper tray most users will find mandatory), the IIP threatens a large chunk of the dot matrix market; it has a rated speed of 4 ppm and brought home a score of 3.9 ppm on our tests. If you're still entrenched in the dot matrix market and absolutely must know how that translates into cps, here's the best formula we could devise:

- Take a typical formatted page, which contains approximately 4,000 characters (80 characters per line for 50 lines).
- Multiply it by the laser's ppm rate

you're buying a lot of printers. It also means there are scads of printers for you to choose from at seriously competitive prices. More important, it means that the choices are more numerous and complex: you can choose from among the new printers reviewed here, but also from the printers reviewed in previous years that are still being produced—and a few so new they weren't available in time for review in this year's *PC Magazine* printer issue.

Making matters more complicated are a variety of complementary and competing technologies. Differences in printer technology used to be easy to understand. Until recently, laser-driven page printers and impact dot matrix printers dominated the office printing market. Expensive laser printers with graphics and desktop pub-

lishing capabilities held sway at the high end, while moderately priced 24-pin dot matrix printers dominated the midrange and inexpensive 9-pin dot matrix printers brought up the rear. Other technologies, such as color printing, were only marginally interesting because of high cost, low quality, or sometimes both.

#### MIDRANGE MADNESS

But things have changed in the printer business and will continue to change rapidly during the next year or so. The most widely felt change is happening in the midrange printer market, where the 24-pin impact dot matrix printers that have long held sway are about to be replaced by

moderately priced laser printers.

Ever since the original Hewlett-Packard LaserJet was introduced in 1984, industry pundits have forecasted the imminent arrival of laser printers costing less than \$1,000. The absence of a low-cost laser printer during these years did not prevent the HP LaserJet and its clones from taking the high-end printing business away from old-fashioned daisy wheel printers, but it did keep them out of the much larger midrange office printing market.

Last year, it looked as if Qume's 6-page-per-minute CrystalPrint WP, then priced at \$1,999, might be the low-priced printer everyone was looking for. But its designed-in entry-level orientation, with only a Courier font, limited it to Diablo 630 emulation and diverted its potential

(4, in the case of the HP LaserJet IIP).

■ Divide the total number of characters per minute (16,000 in our example) by 60 (seconds).

And presto magico, you've got something close to a cps rating. Using this formula, the 4-ppm HP LaserJet IIP yields an approximate cps rating of 267—a lot faster than many dot matrix printers.

Making matters even more complicated, in this roundup we ran across one line printer that couldn't be measured in either cps or ppm; we tested the speed of the Printronix line printer in lines per minute (see the sidebar "The Printronix P3040: A Line at a Time").

#### SOPHISTICATED GRAPHICS

To reflect the increasingly sophisticated graphics output that today's printers offer, we've developed brand new graphics tests for this issue. For the first time ever, we tested color output. We've printed the results in the Guides to the color page printers and the color dot matrix printers, so you can see for yourself how each printer handles color. For laser printers and monochrome dot matrix printers, you'll see six levels of gray instead.

Complementing our gray-scale and color tests is a new halftone test: a scanned photograph of Associate Editor Mary Kathleen Flynn that was created specifically for the test and contains a great many shades of gray. We've included this output from every printer tested because it offers a good point of

comparison. But we don't recommend using dot matrix printers to print photographs; dot matrix printers just don't produce a high enough resolution to handle photos well.

The halftone and gray scale/color graphics page doubled as our graphics speed test. For each printer, we've reported how long it took to print the graphics page. In the Printer Guides, you'll see we've converted the result into a rate based on graphics pages per minute (gppm), so you can compare the graphics speed of different printers easily. We've also included the actual length of time—in minutes and seconds—each printer took to output the graphics page.

#### FONTS & FEATURES

The Fonts & Features tests haven't changed—although standard emulations for IBM, Epson, PostScript, HP PCL, and others have been written into the test files. In the Printer Guides you'll see a sample text output—loosely adapted from *A Man for All Seasons*—that shows some of the fonts and features each printer offers. Each review is accompanied by a table telling you which fonts and features are available in each printer's main emulations.

This year's printers offer better paper handling than ever before, prompting us to include more tests of these features. In the reviews, you'll discover which printers jammed on heavy card stock and multipart forms. You'll also learn which printers provide such pa-

per-handling capabilities as straight-through paper paths, paper park, zero-forms tear-off, manual feeds, and envelope bins.

We've continued to measure the noise of each dot matrix printer in decibels. If it was especially loud or quiet, we've reported this in the review.

#### HOW COMPATIBLE IS COMPATIBLE?

This year's suite of tests features tougher HP PCL and PostScript compatibility tests. The PCL torture test evaluates just how compatible LaserJet-compatible printers really are. In the reviews, you'll learn which printers passed with flying colors and which crashed on PCL macros and font downloading.

For PostScript printers, we've introduced a status page that reveals the version of PostScript used, the existing and available memory, and the printer's resident fonts. PostScript printers were also tested for their ability to use the Ctrl-D end-of-job character and the "executive" command for entering interactive mode—two commands that can cause severe problems for PostScript emulators. Turn to the reviews to see the results of these tests.

This issue contains test results for 109 printers—the largest pool of printers we've come across in 5 years. These results—printed in the Guides, Fonts & Features tables, and reviews—will let you see, quickly and painlessly, how each printer will perform in your office. Take a careful look before you decide which to buy. ■



from the office market to curiosity seekers.

But this year, there are a number of 6-ppm printers on the market, many with serious enough capabilities to take on the mid-range office market. This year's roundup includes six 6-ppm printers that offer LaserJet II emulation: Desktop Systems' Laser Beam, Epson's EPL-6000, the Mannesmann Tally 905, the NCR 6435, the Ricoh PC Laser 6000/PS (which also offers PostScript), and Spear's Desktop Laser Printer.

More 6-ppm lasers are on the way: the Toshiba PageLaser6—priced at a mere \$1,899—wasn't available for review but should be shipping by the time you read this. Also not ready in time was the \$1,995 Facit P6060. The NCR and Toshiba printers even take HP font cartridges instead of custom models. That means you can use these printers next to your LaserJet and standardize on HP's new, less expensive, and less complicated line of cartridges without worrying about font compatibility. With prices ranging from \$1,355 to \$2,395 (and \$4,495 for the PostScript Ricoh) at press time, these 6-ppm printers don't cost nearly as much as a LaserJet Series II, but they also don't carry the Hewlett-Packard name.

#### SLOW SPEED AHEAD

But the new HP LaserJet Series IIP (reviewed in this issue) *does* carry the Hewlett-Packard name and, at \$1,495 (which translates to a street price of about \$995) and a speed of 4 ppm, opens midrange office printing to laser printers in a big way. The Canon-engined printer's low speed is not a deterrent in its target single-user desktop PC market. Based on a 4,000-character page, 4 ppm is around 266 characters per second—quite a bit faster than the IBM Proprinter X24E (also reviewed here) in draft mode. Besides, the HP Series IIP has enough nifty features to compensate for its slower speed.

The Series IIP can accept all HP font cartridges. Like the Series II, it comes with 512K of standard memory, expandable to 4MB. The new printer has a collapsible, adjustable paper tray that holds 50 sheets of letter, legal, A4, or executive paper, or 15 envelopes. Most users will opt to buy the \$195 adjustable 200-sheet tray that bolts to the bottom and can be used as an

*For the features section of this issue, the associate editor was Mary Kathleen Flynn, and the PC Labs project leader was Bill O'Brien.*

## THE BEST OUTPUT IN THE LAND

by Mary Kathleen Flynn

When it comes to print quality, dollars make a huge difference—the difference between ugly output and spectacular page proofs. If your budget has room for a \$17,000 printer, you'll get 600-dot-per-inch output that approaches typesetting quality. The same cash will buy you 300-dpi vivid color page proofs. For as little as \$1,000, you'll bring home 300-dpi monochrome output that's good enough for most busi-

style, try a color PostScript printer. Priced between \$8,500 and \$16,000, these printers belong in the corporate art department or in a professional service bureau. QMS's ColorScript 100 Models 10 and 30—priced at \$9,995 and \$15,995, respectively—produce the best color page proofs to come out of a PC printer.

For 300-dpi monochrome output, the least-expensive printer reviewed here is the new 4-page-per-minute Hewlett-Packard LaserJet Series IIP, with an expected street price of around \$1,200 (including an optional bottom paper tray). HP's Canon-based LaserJet Series IIs set the standard for 300-dpi output. Only one 300-dpi laser reviewed here boasts finer distinctions than the LaserJet II: Canon's own \$2,995 LBP-8 Mark III.

In the dot matrix arena, the clear output winner isn't a dot matrix at all. HP's \$995 ink-jet-based 300-dpi DeskJet Plus prints better-quality output than anything else near its \$700 street price. For an in-depth evaluation of the DeskJet Plus, see the sidebar "HP DeskJet Plus: A Lot like a Laser."

Twenty-four-pin dot matrix printers may make multipart-form printing a breeze, but they sure don't produce good halftones. The \$499 NEC Pinwriter P2200XE produces some of the best 24-pin output you'll see. Other printers, such as Tandy's DMP 300, offer about the same.

Color is increasingly living up output from dot matrix printers. If you'd like to brighten up the charts in an internal report without breaking the budget, try the four-color output from Epson's LQ-2550, Genicom's 1040, or Star Micronics' XB-2415 Multi Font.

If you want output that you can show off, don't even bother with a 9-pin dot matrix. Among the best of this low-quality lot are AT&T's 570, Epson's FX-1050, Hyundai's HDP 910, and Laser Computer's Laser 190E. By all means, use your 9-pin dot matrix for point-of-sale and other forms-based applications, but don't expect it to produce output that will impress anybody. ■

Of the printers we  
reviewed, the highest-  
quality output we found  
this year came from the  
Varityper VT600P. This  
600-dpi PostScript  
printer makes halftones  
that look like  
newspaper photos.

ness applications. But if \$500 is the highest that you can go, you should probably leave desktop publishing to the graphics department.

Of the printers we reviewed—those that offered at least one of the standard PC printer emulations—the highest-quality output we found this year came from the Varityper VT600P. At 600 dpi, this \$16,995 PostScript printer makes halftone prints that look like newspaper photos.

Also worth noting is the LaserMaster 1000, a \$7,495 PostScript machine that works only with specific applications (see the sidebar "LaserMaster 1000: Typesetter-Quality 1,000 by 400 dpi").

If four-color output is more your

**Varityper VT600P**

\$16,995 600-dpi PostScript laser printer

**GMS ColorScript 100 Model 10**

\$9,995 300-dpi PostScript color page printer

**Hewlett-Packard LaserJet Series IIP**

\$1,495 300-dpi laser printer

**Hewlett-Packard DeskJet Plus**

\$995 300-dpi ink jet printer

**NEC Pinwriter P2200XE**

\$499 24-pin dot matrix printer



alternate bin or as a second bin—boosting the expected street price of the whole package to roughly \$1,200. All this comes in a 25-pound package that, with the paper tray folded out of the way, takes up a mere 1.5 square feet of desktop real estate.

Okidata's Okilaser 400—which did not come out in time for this roundup but will be priced between \$1,600 and \$1,800—is also a 4-ppm printer, powered by an LED engine made by Okidata. At 2.2 square feet, it's a bit larger than the Hewlett-Packard machine but also lighter at 23.5 pounds. It emulates the LaserJet Series II but takes Okidata's custom credit-card-size font cards instead of HP cartridges. Its 512K of standard memory can be expanded to 2.5MB, and it accepts standard HP-format downloadable fonts.

You can expect the Canon laser engine used in the new HP LaserJet Series IIP to show up in the HP clone market very quickly, and you may see it in the PostScript market as well, although its low-end performance will probably make it unattractive there. Okidata intends to enter the OEM market with its new LED engine, so expect to see other names on it soon. No one will be surprised to see Mita, Ricoh, Kyocera, TEC, and other page-printer manufacturers quickly enter the OEM printer scene with new low-end products.

Whatever the engine, a laser printer on every PC user's desk could become a reality. It's likely that these inexpensive lasers will take huge chunks out of the 24-pin dot matrix market. The 4-ppm printers may also eat into the sales of HP's DeskJet Plus, often considered the poor man's laser: its current street price is only about \$300 less than the IIP's estimated street price (without the bottom tray). At press time, HP had no plans to lower the price of the DeskJet Plus, asserting that the gap makes a significant difference in the home office and small-business market.

These inexpensive lasers hold an important promise for middle management and other professional office workers whose turnaround requirements make network printing less than satisfactory. There will still be a place for large-volume, 12-ppm or faster laser printers in office pool applications, where networking-style printer access and management is more than adequate.

**RAINBOW OUTPUT**

Besides faster engines, the high-end laser printing market is seeing enormous advances made in color printing and high-



resolution engines. Color printing has slowly but surely moved from a black art to high technology; today it stands ready to meet the needs of desktop publishing, CAD, and other important segments of the graphics market at an affordable price. The QMS Model 30 color printer, which was originally priced at \$24,995, has been brought down to \$15,995; the Tektronix Phaser goes for \$13,000, and the QMS Model 10 goes for an astounding \$10,000.

If these prices sound high, compare them with the cost of alternative technologies. One measure of color printing's effectiveness is that *PC Magazine's* art department produces page proofs using color printers driven by PostScript and desktop publishing technology. The alternative of using 3M colorkey for proofs costs about \$750,000 more a year, and all it takes to save that much money is one color printer.

Thermal technologies, principally wax transfer and variations of wax transfer, have dominated the color printing scene. Other technologies, including true color lasers and Howtek's extraordinary plastic droplet machine, have also proven effective. This year's crop of reasonably priced color page printers has earned its own section in the *PC Magazine* guide to printers.

#### MORE DOTS PER INCH

There aren't enough new high-resolution printers to merit a special section this year, but they do merit special interest. The expected move was from 300 to 600 dots per

inch, but 400 dpi seems more likely to dominate the high-resolution scene in the near future. The AGFA P3400 PS, reviewed in this issue, offers 400 dpi, and NewGen Systems was readying a 400-dpi printer with a list price of \$6,495 as we went to press.

The reason we haven't seen a flood of 600 dpi printers this year is because the toner granularity is not yet fine enough to make 600 dpi effective in laser printing technology. The hard-disk-equipped, 10-ppm \$17,000 Varityper VT600P, with its smaller-particle, 8-micron toner, is the only new 600-dpi printer tested in this year's printer guide. Other high-resolution machines include the \$7,500 LaserMaster 1000 (also reviewed here), which is distinguished by its 1,000- by 400-dpi typesetter-quality output.

#### HOW LOW CAN YOU GO?

The drift toward lower-priced 24-pin dot matrix printers got a hearty shove last year when Panasonic surprised everyone with its \$530 KX-P1124. The new low-priced lasers from HP, Okidata, and others will give that movement an even bigger shove, and you can expect prices to drop on existing 24-pin printer models during the coming year. That, in turn, will put increased pressure on 9-pin dot matrix printers, although with street prices already hovering as low as \$175, it's hard to imagine how

much lower the prices can get.

Prices are dropping, but vendors are also adding value to their low- and medium-range dot matrix printers. Most of the value comes in the form of better paper-handling equipment, such as paper parking and cut-sheet bin feeders. Many of this year's dot matrix printers offer better front-panel controls, menu systems, and other displaying and controlling options. An important source of added value remains in the heavy-duty printers required for invoice and other high-volume, multiple-part form-printing applications.

A large share of added value in low-end printers comes in the form of color capability, reduced size, and portability. There are so many color-capable dot matrix printers on the market that this year's printer issue includes a section for the technology. Fifteen dot matrix printers can give you color graphics and text printing for well under \$1,000. That's a lot less than you'd have to spend for high-end color page printing, and if your color needs are modest, these printers will be more than adequate.

Until this year, laptop and portable PC users have been on the short end of the stick when it comes to printing. Kodak's Diconix printers were previously the only machines designed to meet the needs of traveling users. This year, that's changed enough to earn portable printers a special section in this issue. Lighter printers, some of which are battery-powered, are finally

#### PC Magazine

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Stephen Lewiski is a partner at Bottom Line Technology, a New York-based consultancy.

available in numbers large enough to give you a decent choice and, in some cases, to turn deskbound users into folks who take DOS on the road.

#### WHAT'S OUT...

Whatever kind of PC printer you're looking for, you're going to find it covered here and in the Index to Printer Reviews (1984-1989) at the back of the magazine. With 109 printers, this is the largest printer guide *PC Magazine* has produced since the first one 5 years ago.

The printers we chose to evaluate this year have never been reviewed in a *PC Magazine* feature before. Most were introduced within the last year. To be included here, a printer had to meet our basic criteria:

●

**This year we've  
enhanced our evaluation  
with tests for color  
and halftone output.**

●

ria: it had to get here on time; it had to work; it had to work with a PC; it had to include everything that would make it run—that is, if it depended on software like *Freedom of Press*, that software had to be bundled in the standard unit; and it had to offer at least one of the six standard PC printer emulations: Apple LaserWriter, IBM Graphics, IBM Proprinter, Epson, Diablo, or HP LaserJet.

It's hard to believe that the PC printer industry produced more than 109 printers this year, but there are some printers we were unable to review. These models didn't arrive in time: AT&T's 593, Facit's C7500, P6060, and T9500, NewGen Systems' Turbo PS/300 and PS/400, Sharp's JX-730 and JX-9500, the Toshiba Page-Laser6, the Okidata OkiLaser 400, and the Lasersmith and Texas Instruments lines.

Some vendors, such as CSS Laboratories, GCC Technologies, and Printware, were unable to provide us with working units. And we declined to review some others: Mitsubishi's 330 and 650, as well as the Florida Digital 3000, because they didn't offer any of the standard emulations; the Infoscrite 8400 because it's a text-only forms printer not intended for

graphics; and the BlueChip Personal Page Printer because it's identical to the Fujitsu RX7100 reviewed in this issue.

#### ... AND WHAT'S IN

We've organized this year's crop of printers into five sections: laser, color page, monochrome dot matrix, portable, and color dot matrix. Each section has its own introduction, Printer Guide, and Editor's Choice selections.

The introduction to each section gives you the big picture, defining the issues and parameters of each category. It also points out the features that differentiate printers within their categories.

Turn to the Printer Guides for quick comparisons. In them, you'll find prices, engine technologies, and test speed results for text and graphics. You'll also see sample output: gray-scale or color and a scanned photo to show you halftone output.

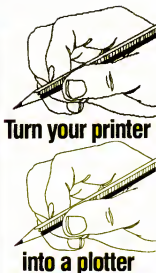
Each review offers an in-depth evaluation of the printer and its features. Each is accompanied by a fact file and a Fonts & Features grid, showing you the fonts you'll get in the printer's main emulations.

To understand our testing methodology, see "How We Tested the Printers," which also explains the legends for the Guides and the Fonts & Features grids. This year we've enhanced our evaluation process with new tests for color and halftone output. You'll be pleased to hear we've managed to maintain "backward" compatibility: you can compare the test speed results of this year's printers with the printers tested in all previous years.

For a panorama of the highest-quality output at each level of technology, see "The Best Output in the Land." If you need a primer on printer engine technology, turn to "Lights! Camera! Print! It! Laser Printer Technology Explained" and "Dot's Good Enough for Me!: Dot Matrix Technology Explained." Need tips on buying paper for your printer? See "Paper for Page Printers" and "Paper for Dot Matrix Printers." If you already have a laser model, take a look at "How to Get the Most Out of Your Laser Printer." And to prepare yourself for tomorrow's printer interfaces, see "Printer Languages: The Next Generation."

Whatever you want to know about PC printers, you'll find it here. And with 109 printers to choose from, our work is over and yours has just begun.

Enjoy.



Imagine your present printer turning out crisp, high resolution plots while you continue to work, without interruption, at your PC.

The EoGraph Plus add-on board lets you do that, and more.

You have total control over eight different line widths, and as many colors as your printer offers.

You can produce drawings 15 feet long, and longer, in any carriage width.

How about multiple plots, or automatic queuing of text and plots? Yes, the EoGraph Plus lets you do that, too—with ease.

Think of it! Using virtually any CAD or graphics program, you can work at your PC while your printer generates plotter-quality drawings with nearly incredible detail.

Best of all, you get all of this without the headaches, or expense, of baby sitting a plotter.

Thousands of users agree: No other PC add-on can increase your productivity, or pay for itself so quickly, as the EoGraph Plus.

It may sound too good to be true, until you call for the facts, toll-free, at 1-800-548-5780.

#### DEALER INQUIRIES WELCOME

Estren Corp. / 121 Westpark Road / Dayton, OH 45428  
Please send information and independent test reports to

NAME		
ADDRESS		
CITY	STATE	ZIP

CIRCLE 341 ON READER SERVICE CARD

*Engineered for the office. Designed for people.*

After you ooh-ed and aah-ed over the letter quality output, 3-way paper feed, ease-of-use, 2-year limited warranty, and 9 pin price on our KX-P1124 printer, somebody said, "Great. Now do it with a wide-carriage."



*Introducing the  
Panasonic® KX-P1624.  
Our newest 24 pin  
wide carriage  
printer.*

It's fast. Flexible. And fully-featured. Everything most offices are looking for in a dot matrix printer. At a price within most office budgets.

The features you'll use most often are available at a touch. Seven resident fonts to vary the look of your documents. Formatting for different document sizes.

Draft Plus  
Draft Elite  
Courier Plus  
Prestige Elite  
Bold Proportional  
Sans Serif Plus  
Script Plus

True letter quality, high-resolution graphics, and seven resident fonts, so it's ideal for all your office applica-

tions. You'll find the 1624's letter-quality mode as fast, or faster, than most popular 9 pins. Up to 63 LQ characters per second. With its 360 x 360 dpi bit-mapped graphics, you can incorporate special printed effects into your documents. Like company logos and line art.

20 features, including 4 macros, right at your fingertips. What could be simpler?

Even macros that recall all the settings for a particular document at the touch of a single key.



# Done.



Multiple paper paths mean you can put this printer exactly where you want it. There aren't many places in an office to conveniently put a printer.

So the 1624 gives you a choice of 4 different paper paths: single sheets from the top, and fanfold from the front, rear, and bottom.



Only one paper path is available at any given time for continuous paper.

bottom or rear. A special 'Paper Park' feature even lets you feed single sheets from the top, without removing rear-fed fanfold. A 2-year limited warranty in this day and age? That's investment protection, Panasonic-style. You'll find 2-year warranties rather rare in the printer industry. But standard with the Panasonic 1624.



See your dealer for details.

So if you've been waiting for the ideal multi-purpose office printer, it has arrived. For the name of your nearest Panasonic printer dealer, call toll-free 1-800-742-8086.

Printers, Computers, Peripherals, Copiers, Typewriters and Facsimiles

**Panasonic**  
Office Automation *OA*

CIRCLE 138 ON READER SERVICE CARD

For a quick look at the 109 printers reviewed in this issue, turn to the **PC Magazine Printer Guides** at the front of each section of reviews. In the Guide, you'll find the results of our PC Labs tests and a listing of each printer's most important features, as well as its price.

### Gray-Scale or Color Output

In the Guides to Laser Printers and Monochrome Dot Matrix Printers, we've included six shades of gray printed by each printer. Comparing the gray scale and the scanned photo image will give you a good sense of how each printer handles halftones.

For the Guides to Color Page Printers and Color Dot Matrix Printers, we've included the results of our brand new color test. To see how each printer handles color, take a look at how it prints the six colors in our test: blue, red, magenta, green, cyan, and yellow.

### Fonts & Features

Each printer review is accompanied by a Fonts & Features table that shows you what features, or enhancements, are available with each font offered under one or two emulations.

For laser printers, we've shown what features are available with four common fonts—Helvetica, Times, Courier, and Line Printer—in four different point sizes—8/9, 10, 12, and 14. Since some lasers, like the PostScript printers, let you choose a font in any size you want, we've also included Scalable. Please note that for some printers, such as the LaserJet II, what we call a feature—the bold enhancement to the Courier font, for example—is actually a separate font called *Courier Bold* in HP-esc.

For dot matrix printers, we've shown what features are offered at four widths: 10 characters per inch (10 cpi, or 12 pitch), also known as *pica*; 12 cpi, or 12 pitch, also known as *elita*; compressed, somewhere between 15 and 20 cpi; and proportional, which lets narrower characters, such as *i*, take up less space than wider characters, such as *w*.

For samples of some of the fonts and features for each printer, see the text output in the five PC Magazine Guides.

### Brother HL-8e

### Fonts & Features

HP LaserJet II											
	Helvetica	Times	Courier	Line printer							
	Bold	Underline	Subscript	Superscript	Bold	Underline	Subscript	Superscript	Bold	Underline	Subscript
8/9-point											
10-point											
12-point											
14-point											
Scalable											

### IBM Proprinter XL

	Bold	Underline	Subscript	Superscript
10 cpi				
12 cpi				
Compressed				
Proportional				

The Brother HL-8e expands on the LaserJet emulation by adding proprietary Times and Helvetica fonts.

### Bar Charts

To compare the speeds of printers in each section, see the bar charts. Each actual speed is accompanied by a read-at-a-glance bar chart. On all printer speed bar charts in this issue, longer bars mean faster printers.

### Text Speed

Rather than relying on the rated speed supplied by manufacturers, PC Labs timed each printer's text and graphics output speeds. The reported text speed tells you the rate at which each reviewed model printed our Arthur D. Author test—a two-page single-spaced business letter. For dot matrix printers, the unit of measurement

was characters per second (cps); for laser printers, pages per minute (ppm). Two speeds are given for dot matrix printers: one based on the printer's performance in default mode, the other based on its best (or nearest-letter) quality. Laser tests report the text speed of each printer in its default mode.

### Hewlett-Packard LaserJet II

\$1,495 Laser with \$195 optional bottom tray



### Graphics Time

To find out how long you'll have to wait for each printer to output a typical graphic image, take a look at how long it took to print our scanned photo, reported here in minutes and seconds.

### Graphics Speed

Our graphics output test doubles as our graphics speed test. In addition to reporting the actual time each printer took to output the scanned photo, we've converted that time into a rate that we named graphics pages per minute (gppm) and have shown with a bar chart. We've also indicated the emulation under which the graphic was produced.



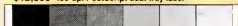
Once you've torn down laws in the country yourself face to face with the Devil, what will you do? **Courier Bold Underline** Line Printer Bold Underline Compressed Courier 12 Pitch Bold Underline

### Graphics Output

At PC Labs, we tested each printer's ability to handle graphics output with this scanned photo of associate editor Mary Kathleen Flynn, which was taken specifically for the test and contains many shades of gray. We've included this graphics sample for all printers to make it easy for you to compare their halftone output, but we don't recommend printing photos with dot matrix printers. As you can see from the generally poor quality of the dot matrix printer's graphics output, you're better off sticking to lasers when it comes to printing photos.

### Text Output

To see how each printer's text output looks, read the quote, loosely adapted from *A Man for All Seasons*, which offers a sample of fonts and features. And for a list of which features are available with which fonts under which emulations, see the Fonts & Features table accompanying each review.

**AGFA P3400-PS****\$12,500** 400-dpi PostScript dual-tray laser

Text Speed **DEFAULT** 10.5 ppm  
0 3 6 9 12 15 ppm

Graphics Speed **POSTSCRIPT** 1 min. 49 sec.  
0 5 1 1.5 2 2.5 3 gppm 0.6 gppm



Once you've torn down all of laws in the country and you find yourself face to face with the Devil, what will you hide behind? **Courier Bold Underline** Palatino Bold Underlined

**PC Brother HL-80****\$2,895** LaserJet II-compatible laser

Text Speed **DEFAULT** 7.4 ppm  
0 3 6 9 12 15 ppm

Graphics Speed **HP LASERJET II** 31 sec.  
0 5 1 1.5 2 2.5 3 gppm 1.9 gppm



Once you've torn down all laws in the country and you find yourself face to face with the Devil, what will you hide behind? **Courier Bold Underline** Line Printer Bold Underline Compressed BR-TMS Bold Underline

**PC Brother HL-8PS****\$4,495** PostScript laser

Text Speed **DEFAULT** 7.4 ppm  
0 3 6 9 12 15 ppm

Graphics Speed **POSTSCRIPT EMULATOR** 5 min. 9 sec.  
0 5 1 1.5 2 2.5 3 gppm 0.2 gppm



Once you've torn down all of laws in the country and you find yourself face to face with the Devil, what will you hide behind? **Courier Bold Underline** Palatino Bold Underlined

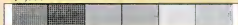
**Camiononn TurboLaser/PS-Plus 3****\$5,695** PostScript and LaserJet II-compatible laser

Text Speed **DEFAULT** 6.5 ppm  
0 3 6 9 12 15 ppm

Graphics Speed **POSTSCRIPT** 15 min. 47 sec.  
0 5 1 1.5 2 2.5 3 gppm 0.1 gppm



Once you've torn down all of laws in the country and you find yourself face to face with the Devil, what will you hide behind? **Courier Bold Underline** Palatino Bold Underlined

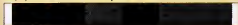
**Canon LBP-8 Mark III****\$2,995** Laser with Diablo emulation

Text Speed **DEFAULT** 7.3 ppm  
0 3 6 9 12 15 ppm

Graphics Speed **LBP-8 MARK III** 47 sec.  
0 5 1 1.5 2 2.5 3 gppm 1.3 gppm



Once you've torn down all of laws in the country and you find yourself face to face with the Devil, what will you hide behind? **Courier Bold Underline** LinePrinter Bold Underline Compressed Swiss1-127 CPI Courier B

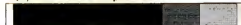
**Desktop Laser Beam****\$1,995** LaserJet II-compatible laser

Text Speed **DEFAULT** 5.6 ppm  
0 3 6 9 12 15 ppm

Graphics Speed **HP LASERJET** 58 sec.  
0 5 1 1.5 2 2.5 3 gppm 1.0 gppm



Once you've torn down all laws in the country yourself face to face with the Devil, what will you hide behind? **Courier Bold Underline** Line Printer Bold Underline Compressed

**HP AGFA P3400 PS**
**\$1,899 LaserJet II-compatible laser**


**Text Speed** **5.4 ppm**

**Graphics Speed** **59 sec. 1.0 gppm**

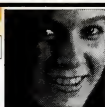


Once you've torn down laws in the country yourself face to fac  
Devil, what will you Courier Bold Underli  
Line Printer Bold Underline Compe

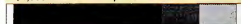
**PC Brother HL-8e**
**\$4,499 PostScript LCS**


**Text Speed** **6.0 ppm**

**Graphics Speed** **1 min. 52 sec. 0.5 gppm**



Once you've torn down all of laws in the country and you fi  
yourself face to face with the Devil, what will you hide beh  
Courier Bold Underli  
Palatino Bold Underlined

**PC Brother HL-8PS**
**\$1,999 LaserJet II-compatible LCS**


**Text Speed** **5.8 ppm**

**Graphics Speed** **35 sec. 0.7 gppm**



Once you've torn down laws in the country yourself face to fac  
Devil, what will you Courier Bold Underli

**Camintonn TurboLaser/PS-Plus 3**
**\$2,150 LaserJet Plus-compatible LED**


**Text Speed** **5.2 ppm**

**Graphics Speed** **1 min. 20 sec. 0.6 gppm**



Once you've torn down laws in the country yourself face to fac  
Devil, what will you Courier Bold Underli  
Line Printer Bold Underline Compe

**Canon LBP-8 Mark III**
**\$4,495 PostScript and LaserJet II-compatible LED**


**Text Speed** **5.1 ppm**

**Graphics Speed** **1 min. 54 sec. 0.5 gppm**



Once you've torn down all of laws in the country and you fi  
yourself face to face with the Devil, what will you hide beh  
Courier Bold Underli  
Palatino Bold Underlined

**Desktop Laser Beam**
**\$3,995 LaserJet Plus-compatible LED**


**Text Speed** **11.4 ppm**

**Graphics Speed** **1 min. 13 sec. 0.8 gppm**



Once you've torn down laws in the country yourself face to fac  
Devil, what will you Courier Bold Underli  
Line Printer Bold Underline Compe



**HP LaserJet 4000****\$7,950** LaserJet Plus-compatible LED

Text Speed **DEFAULT** 14.8 ppm  
0 3 6 9 12 15 ppm

Graphics Speed **HP LASERJET PLUS** 30 sec. 2.0 gppm  
0 .5 1 1.5 2 2.5 3 gppm



Once you've torn down  
laws in the country  
yourself face to fac  
Devil, what will you  
Courier Bold Underli  
Line Printer Bold Underline Compr

**HP Hewlett-Packard LaserJet Series II-D****\$4,295** Dual-tray laser with duplex

Text Speed **DEFAULT** 7.5 ppm  
0 3 6 9 12 15 ppm

Graphics Speed **HP LASERJET II** 36 sec. 1.7 gppm  
0 .5 1 1.5 2 2.5 3 gppm



Once you've torn down all o  
laws in the country and you f  
yourself face to face with the  
Devil, what will you hide beh  
Courier Bold Underli  
Line Printer Bold Underline Compr  
Times 12 point Bold Underli

**HP Hewlett-Packard LaserJet Series II-P****\$1,495** Laser with \$195 optional bottom tray

Text Speed **DEFAULT** 3.9 ppm  
0 3 6 9 12 15 ppm

Graphics Speed **HP LASERJET II** 53 sec. 1.1 gppm  
0 .5 1 1.5 2 2.5 3 gppm



Once you've torn down  
laws in the country  
yourself face to fac  
Devil, what will you  
Courier Bold Underli  
Line Printer Bold Underline Compr  
Courier 12 Pitch Bold Un

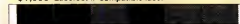
**IBM LaserPrinter****\$2,695** Laser with dual paper trays

Text Speed **DEFAULT** 8.9 ppm  
0 3 6 9 12 15 ppm

Graphics Speed **HP LASERJET II** 37 sec. 1.6 gppm  
0 .5 1 1.5 2 2.5 3 gppm



Once you've torn down  
laws in the country  
yourself face to fac  
Devil, what will you  
Courier Bold Underli  
Line Printer Bold Underline Compr  
Courier Bold Bold Un

**Mannesmann-Tally 995****\$1,995** LaserJet II-compatible laser

Text Speed **DEFAULT** 5.1 ppm  
0 3 6 9 12 15 ppm

Graphics Speed **HP LASERJET II** 1 min. 5 sec. 0.9 gppm  
0 .5 1 1.5 2 2.5 3 gppm

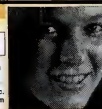


Once you've torn down  
laws in the country  
yourself face to fac  
Devil, what will you  
Courier Bold Underli  
Line Printer Bold Underline Compr  
Courier Bold Underli

**Mannesmann-Tally 316 UPS****\$5,495** PostScript and LaserJet-compatible laser

Text Speed **DEFAULT** 8.3 ppm  
0 3 6 9 12 15 ppm

Graphics Speed **POSTSCRIPT EMULATOR** 8 min. 11 sec. 0.1 gppm  
0 .5 1 1.5 2 2.5 3 gppm



Once you've torn down all of  
laws in the country and you f  
yourself face to face with the  
Devil, what will you hide beh  
Courier Bold Underli  
Palatino Bold Underlined

## NCR 5436

\$2,395 LaserJet II-compatible laser



Text Speed **DEFAULT** 5.6 ppm

Graphics Speed **POSTSCRIPT** 56 sec. 1.0 gppm



Once you've torn down laws in the country yourself face to face with the Devil, what will you Courier **Bold Underli**  
Line Printer Bold Underline Com  
Courier **Bold Underli**

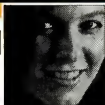
## NEC Silentwriter LC 890XL

\$6,995 PostScript and LaserJet II-compatible LED



Text Speed **DEFAULT** 7.4 ppm

Graphics Speed **POSTSCRIPT** 1 min. 49 sec. 0.6 gppm



Once you've torn down all of laws in the country and you fi yourself face to face with the Devil, what will you hide beh Courier **Bold Underli**  
Palatino Bold Underlined

## Framitronix L2324 Report Expediter

\$15,500 LED with dual paper trays



Text Speed **DEFAULT** 20.9 ppm

Graphics Speed **POSTSCRIPT** 16 sec. 3.4 gppm



Once you've torn down all laws in the country and you yourself face to face with the Devil, what will you hide be Courier **Bold Underli**  
Line Printer Bold Underline Com  
Helvetica Prop/12 pt **Bold**

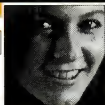
## QMS PS-820

\$6,495 PostScript dual-tray laser



Text Speed **DEFAULT** 6.9 ppm

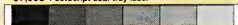
Graphics Speed **POSTSCRIPT** 2 min. 12 sec. 0.45 gppm



Once you've torn down all of laws in the country and you fi yourself face to face with the Devil, what will you hide beh Courier **Bold Underli**  
Palatino Bold Underlined

## QMS PS-1500

\$7,995 PostScript dual-tray laser



Text Speed **DEFAULT** 8.8 ppm

Graphics Speed **POSTSCRIPT** 1 min. 38 sec. 0.6 gppm



Once you've torn down all of laws in the country and you fi yourself face to face with the Devil, what will you hide beh Courier **Bold Underli**  
Palatino Bold Underlined

## PC QMS PS-2200 Model S

\$12,995 PostScript dual-tray laser, 11- x 17-inch paper

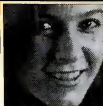


Text Speed **DEFAULT** 13.5 ppm

Graphics Speed **POSTSCRIPT** 1 min. 40 sec. 0.6 gppm



Once you've torn down all of laws in the country and you fi yourself face to face with the Devil, what will you hide beh Courier **Bold Underli**  
Palatino Bold Underlined

**Qume CrystalPrint Publisher****\$4,499** PostScript LCSText Speed **DEFAULT** 5.1 ppmGraphics Speed **POSTSCRIPT EMULATOR** 2 min. 45 sec. 0.4 gppm

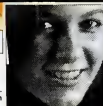
Once you've torn down all of laws in the country and you find yourself face to face with the Devil, what will you hide behind?

**Courier Bold Underline**  
**Palatino Bold Underlined**

**Haster Devices Direct Impression****\$2,495** LaserJet II-compatible laserText Speed **DEFAULT** 4.1 ppmGraphics Speed **HP LASERJET** 2 min. 0 sec. 0.5 gppm

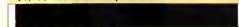
Once you've torn down all of laws in the country and you find yourself face to face with the Devil, what will you hide behind?

**Courier Bold Underline**  
**Line Printer Bold Underline Compressed**  
**Charter 12 Bold Underline**

**Ricoh PC Laser 8000/PS****\$4,495** PostScript and LaserJet II-compatible laserText Speed **DEFAULT** 5.3 ppmGraphics Speed **POSTSCRIPT** 2 min. 1 sec. 0.5 gppm

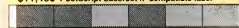
Once you've torn down all of laws in the country and you find yourself face to face with the Devil, what will you hide behind?

**Courier Bold Underline**  
**Palatino Bold Underlined**

**Spear Desktop Laser Printer****\$1,495** LaserJet II-compatible laserText Speed **DEFAULT** 5.2 ppmGraphics Speed **HP LASERJET II** 58 sec. 1.0 gppm

Once you've torn down all of laws in the country and you find yourself face to face with the Devil, what will you hide behind?

**Courier Bold Underline**  
**Line Printer Bold Underline Compressed**  
**Bold Underline Compressed**

**Talaris 1590-T Printstation****\$11,490** PostScript LaserJet II-compatible laserText Speed **DEFAULT** 11.0 ppmGraphics Speed **POSTSCRIPT EMULATOR** 14 min. 52 sec. 0.07 gppm

Once you've torn down all of laws in the country and you find yourself face to face with the Devil, what will you hide behind?

**Courier Bold Underline**  
**Palatino Bold Underlined**

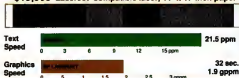
**Unisys AP 5200****\$2,995** LaserJet-compatible laserText Speed **DEFAULT** 5.8 ppmGraphics Speed **HP LASERJET PLUS** 1 min. 6 sec. 0.9 gppm

Once you've torn down all of laws in the country and you find yourself face to face with the Devil, what will you hide behind?

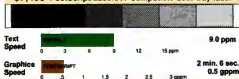
**Courier Bold Underline**  
**Line Printer Bold Underline Compressed**  
**Times Roman Bold Underline**

**Unisys AP 9215-1****\$6,285** LaserJet-compatible dual-tray laser

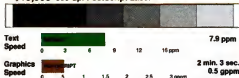
Once you've torn down all laws in the country and y yourself face to face with Devil, what will you hide Courier Bold Underli  
Line Printer Bold Underline Compr  
Century Bold Underline C

**Unisys AP 9230****\$19,500** LaserJet-compatible laser, 11- x 17-inch paper

Once you've torn down all of the laws in the country and you find yourself face to face with the Devil, what will you hide behind? Courier Bold Underli  
Line Printer Bold Underline Compr  
Helvetica 8 point Bold Underline Compr

**Unisys AP 3415****\$7,495** PostScript/LaserJet-compatible dual-tray laser

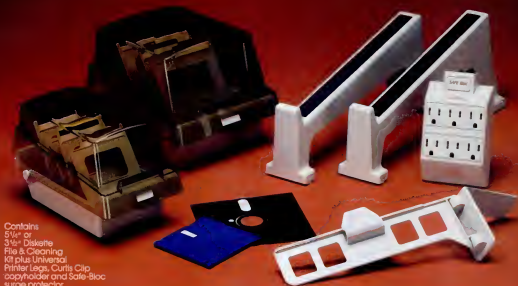
Once you've torn down all of laws in the country and you fi yourself face to face with the Devil, what will you hide beh Courier Bold Underli  
Palatino Bold Underlined

**PC Vantyper VT600P****\$16,995** 600-dpi PostScript Laser

Once you've torn down all of laws in the country and you fi yourself face to face with the Devil, what will you hide beh Courier Bold Underli  
Palatino Bold Underlined

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getting faster and slower,  
bigger and smaller.

Best of all,  
they're getting cheaper.

*by Alfred Poor*

Zap! Flash! Pow! Nope, it's not the soundtrack for *Batman*—it's the sound of laser printers taking over. Daisy wheel printers have been banished to mail-order surplus dealers, and now other traditional print technologies are feeling the pressure from these high-tech powerhouses.

Of course, it's misleading to use the term "laser" to cover all of these machines. The fact is that while most do use laser print engines, many are using alternative technologies (see the sidebar "Lights! Camera! Print It! Laser Printer Technology Explained"). With few exceptions, however, these devices are all putting toner down on cut sheets of plain paper. Page printer is a better term for them, since we measure their speed in terms of the number of pages they can print in a minute. And while 300-dot-per-inch text in Times Roman and Helvetica fonts used to take our breath away, it is rapidly becoming the expected norm for PC output.

Understandably, printer manufacturers are now working to expand the laser market. This process involves movement at both ends of the spectrum.

At the top end, there are more models available with a plethora of features. So, for the first time in the 6-year history of *PC Magazine's* printer issues, we have opened up the top limit in the selection process. As a result, you'll find a variety of printers that cost from \$10,000 to \$20,000 or more. Some offer PostScript running on controllers with configurations that rival that of most PCs—4MB or more of RAM, large hard disks, fast CPUs. Most of these top-end machines are fast, using print engines rated for 15 to 25 pages per minute. These printers may be extreme for a single user, but installations where printers are shared through switching devices or a local area network are increasing. These applications require heavy-duty printers that are fast and have a large enough paper supply to keep up with the work.

Another change at the top end is increased resolution. Printers are going beyond the 300-dot-per-inch standard, with resolutions of 400 to 600 dpi popping up. While the difference is definitely noticeable, most users will probably be satisfied with the lower resolution. But because the new, higher dot densities are indeed visibly better, some users will want them to create good-quality, camera-ready pages for publication.

On the low end, you'll find more pressure at the \$3,000-and-under segment of the market. Some printers are loading up

## PAPER FOR PAGE PRINTERS

by Alfred Poor

Paper is paper, right? Wrong. When it comes to page printers, it pays to know more than just a little about this tree-begotten white stuff we take for granted.

Laser printers have special needs. It's no wonder that supply catalogs list dozens of different types of laser printer paper, with each manufacturer offering a half-dozen varieties of its own. How can you choose which paper to use?

The first step is understanding the printing process. Page printers rely on an electrical charge to hold the toner to the paper, and then heat and pressure to fuse the toner to the page. So it stands to reason that good laser paper will have special electrical- and heat-resistant properties, just as typical copier machine paper does.

The electrical resistance of paper is affected by a number of factors. Paper manufacturers can either add resistant chemicals to the surface of the paper or mix them into the paper itself. The moisture content of the paper also has a significant impact on paper's resistance, explaining why print quality can vary with humidity.

Moisture affects another aspect of the printing process: paper feeding. The greater the moisture content of paper, the more likely it is to curl. And if a page has too much curl, it can be more prone to jamming. As a result, it is important that you store paper carefully and take care to close the packaging on partial reams.

The paper-making process creates paper that has two distinctly different sides, though the difference is not always obvious to the eye or the touch.

The top is called the felt side, and the bottom is called the wire side. During the manufacturing process, stresses are built into the paper that can help minimize curling—the rule is to print on the wire side first. Look at the label on the front of the ream wrapper for an arrow indicating the wire side and keep this in mind when loading your printer's paper trays. And don't forget whether your printer's tray loads faceup or facedown.

Another factor that affects paper jamming is the weight of the paper. Basis weight is a standard measure based on 500 sheets of paper. Most paper is rated at 20 pounds, though some higher-quality paper is rated at 24 pounds or more. Paper that is too light or too heavy is more likely to jam.

Many people assume that *weight* means the same as *thickness* and *stiffness*. In fact, the three measures tend to correlate but are not directly related. Stiffness is a measure of how much a page resists bending, while thickness describes the physical dimension. It is quite possible to have three sheets of different 20-pound paper—one significantly stiffer than the other two, and one noticeably thicker.

Cotton bond paper, as its name suggests, has cotton fibers mixed with the wood pulp that forms the paper. Paper with this mixture often has a high-quality feel and is typically stamped with a watermark as part of the manufacturing process.

There are other factors that affect print quality. *Brightness* refers to the brilliance and whiteness of the paper. *Wax pick* is the strength of the paper's surface; cheap papers can leave lots of

on bonus features. Others are going for low price. It all adds up to new opportunities to get better value for your dollar when buying a 6- to 8-ppm printer.

If you're shopping at the very bottom of the range, keep in mind that there are some important developments just beginning to surface. Included in this issue are reviews of four 6-ppm printers; another one, from Toshiba, was about to ship at press time. But this year also brought a brand new entry-level laser speed: 4 ppm. The 4-ppm

laser is represented here by Hewlett-Packard: its LaserJet Series IIP was ready just in time for review. But at least one more should be out by the time you read this: Okidata's OkiLaser 400, which wasn't available for this article (see introduction by John Dickinson).

These slower-speed laser machines should add some important low-cost alternatives, putting further pressure on the high-end 24-pin impact dot matrix printers. You can count on *PC Magazine* to

lint inside your printer, ruining print quality and shortening engine life. *Opacity* describes how well a page prevents print on the back from showing through to the front. And *smoothness* measures the texture of the page: rough surfaces such as classic laid bonds often do not take toner evenly, but toner doesn't fuse well to very smooth surfaces either and is prone to flaking and falling off them.

When you leave the realm of blank paper and start looking at special supplies, the page printer world gets even more complex.

Envelopes tend to cause some of the biggest headaches for page printers. Hewlett-Packard has run extensive tests on envelopes and recommends those with diagonal seams and standard gummed flaps. This style results in the fewest layers of paper. Another tip from HP that eliminated all my envelope-printing problems was to make certain that the leading edge of the envelope has a sharp crease.

Labels also have special requirements. Since the fusing rollers can be as hot as 200 degrees Fahrenheit or more, you must be sure that the label adhesive can stand the heat. Labels for copiers are designed to take these temperatures, but many labels designed for impact printers can't handle the punishment.

If you wish to add color to your standard black-and-white output, you have a number of options. You can get pages that have been preprinted in another color. Don't try to run raised-ink printing through your laser, however; the thermographic ink will melt in the fuser. Embossing also does not travel well through the heat and pressure of the fusing rollers.

give you a thorough report on these newcomers as soon as they hit the market.

The other important slice of the laser printer market consists of PostScript printers. While Hewlett-Packard LaserJet emulation continues to be important and is offered by many machines, today there are more PostScript-compatible printers than ever before. There is continued pressure to lower prices in this area as well; PostScript printers now start at roughly \$2,000.

Faster and slower, more expensive and

There are many colored papers and preprinted forms available for use with page printers. If you want to get colored print in small quantities, consider the Kroy Color Plus from Kroy Inc. (Scottsdale, Arizona; (800) 521-4997). This separate unit uses sheets of color film that adhere only to the toner and not the paper.

You can cut up the film sheets and mix the colors on your page. It's not a solution for high-volume production, but some bright colors or metal foils can dress up important reports or presentation materials.

There are dozens of new products coming out all the time, and at least one source specializes in supplies for page printers. Intergraphix in Pembroke, Massachusetts ((800) 451-2515) carries products from James River, 3M, Hamermill, and Avery, among others, either specifically designed for lasers or tested for use with them. Intergraphix offers a *Laser Paper Almanac* that contains samples of different papers and other products. Intergraphix also carries die-cut Rolodex cards designed for use in page printers.

The bottom line on page printer supplies is that they need to be of a certain minimum quality. In fact, products designed for use in plain paper copiers will generally work just as well as some of the products that have "laser" in their names. Take the time to test some of the alternatives, and buy only a ream or two of each variety until you find one that serves your purposes. A few pennies more per page can make a big difference not only in the quality of your printing, but in the impression your pages will make on the people who receive them. ■

cheaper, extra features and simpler designs, much bigger and much smaller—the laser printer market is expanding and diversifying like never before. In the pages that follow, you will find that your choices have broadened considerably. No matter what your needs—and almost no matter what your budget—you will probably find a match among the 35 different laser printers we evaluated.

Holy ribbons, Batman! Looks like laser printers are taking over!

## AGFA P3400 PS

by Alfred Poor

At first glance, the \$12,500 price of AGFA Corp.'s P3400 PS may seem a bit steep for a desktop PostScript printer. Indeed, if you want to print only a simple newsletter or two, or maybe your kids' term papers, this printer is certainly more than you'll need. But if you need to crank out lots of pages in a hurry day after day, the features of the AGFA P3400 PS begin to ease the pain of its price.

It helps to start by considering the source: AGFA Corp. bought Compu-graphic, which is one of the leading manu-

### AGFA P3400 PS Fonts & Features

	PostScript				HP LaserJet II			
	Helvetica	Times	Courier	Line printer	Helvetica	Times	Courier	Line printer
	Bold	Italic	Sub-Super Underline	Bold	Italic	Sub-Super Underline	Bold	Italic
8/9-point	■	■	■	■	■	■	■	■
10-point	■	■	■	■	■	■	■	■
12-point	■	■	■	■	■	■	■	■
14-point	■	■	■	■	■	■	■	■
Scalable	■	■	■	■	■	■	■	■

You can access the AGFA P3400 PS's 75 resident PostScript fonts even in LaserJet mode.

facturers of typesetting equipment. As you might expect, the P3400 PS is designed as a professional's printer.

The printer runs genuine Adobe PostScript; our test machine was loaded with PostScript, Version 48.1. The P3400 PS also comes with a whopping 4MB RAM, 2MB of which are devoted to bitmapped memory for page image composition. If this number seems startling, remember that the print engine produces 400- by 400-dot-per-inch resolution on sheets ranging up to legal size.

The P3400 PS also comes with another impressive feature: 73 different resident



# PRINTERS LASER PRINTERS

## AGFA P3400 PS



## PC FACT FILE

AGFA Corp., AGFA Compugraphic Division, 200 Ballardvale, Wilmington, MA 01887; (800) 343-1237, (508) 658-5600.

List Price: \$12,500.

Dimensions (HWD): 21 x 28 x 19.5 in.

Weight: 102.2 lbs.

Emulations: Diablo 630, HP LaserJet Plus,

PostScript.

In Short: Rated at 15 ppm, the AGFA P3400 PS doesn't skimp on features: a 20MB hard disk in addition to 4MB RAM, 73 PostScript typefaces, 400-dpi resolution, and excellent print quality. You'll pay a high price for all these extras, but this printer is worth considering if you need the volume and the quality it offers.

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PostScript typefaces. Some are stored in ROM, as is typical with PostScript printers, but the majority reside on a 20MB hard disk buried inside the printer. Access to these extra typefaces is easy: all you have to do is call for Korinna, Helvetica Black, AvantGarde, or Souvenir (among others), and they will appear on the final page.

The printer offers the standard interface options: serial, parallel, and Apple-Talk/RS-422. There are two 250-sheet input trays, as well as a manual feed slot. Output can be either faceup or face down.

The engine is rated at 15 pages per minute, but the actual results will depend on what you print. In our PC Labs graphics speed test, the P3400 PS took 109 seconds—a score achieved by some of the faster 8-ppm PostScript printers tested in this roundup. In the text speed test, however, the faster engine proved its worth and hit a stride of 10.5 ppm, making it one of the fastest PostScript printers tested.

The print quality of the P3400 PS is excellent. Even an unaided eye can see the difference between 300 and 400 dpi, and with a magnifying glass the contrast is dramatic. Curves are smoother, and the stair-stepping that usually shows up on italic letters all but disappears. Graphics are sharp and crisp, with excellent toner coverage of solid black areas. This printer even makes good-looking halftone images.

The P3400 has its flaws, however. The documentation is horrendous: there are barely 30 pages, with lots of pictures and skimpy information that is repeated in French and German. An index would be a major improvement. The one emulation choice that's resident is a curious anachronism: the Diablo 630 daisy wheel.

A LaserJet emulation is supplied on-disk; it can be made resident on the printer through an install procedure that puts it on the printer's hard disk. The emulation is good but is of little consequence—few people are likely to pay this much for a printer and not use the PostScript mode.

In the end, the AGFA P3400 PS is a large, heavy-duty PostScript machine with a price tag to match. If you need better-than-average print quality, as well as speed for PostScript text output, and you can afford the price, this is a good one to check.

## Brother HL-8e

by M. David Stone

Brother International Corp. has a long history of making printers, but most are daisy wheel—a nearly dead species. Two years ago, Brother introduced its first laser printer, the HL-8. This year, it offers the \$2,895 HL-8e. As the minor change in name implies, this new model offers only incremental improvements. But that's not a disparaging comment—the original HL-8 was good enough to earn *PC Magazine's* Editor's Choice in 1988. The HL-8e is even better.

The original HL-8 offered compatibility with the HP LaserJet, Diablo 630, Epson FX-80, and IBM Proprinter XL. For Brother Twinriter users, it also offered a front-panel menu selection for Twinriter DP and Twinriter WP emulations. (These are identical to the Epson FX-80 and Diablo 630 emulations.) The one drawback of the HL-8 was that the LaserJet compatibility was limited to the LaserJet Plus level. The HL-8e corrects this oversight, adding

full LaserJet Series II emulation. It also adds HPGL graphics compatibility, emulating the Hewlett-Packard 7475A plotter.

On PC Labs emulation tests, the printer performed flawlessly. On our HP LaserJet compatibility test, the HL-8e proved it could handle graphics primitives, downloadable fonts, macros, and other features just like the real thing. It even duplicates such characteristics as not printing in the nonprinting regions and automatically producing a form-feed when switching to landscape mode.

And the HL-8e's LaserJet emulation offers resident fonts that the LaserJet itself doesn't. Where the LaserJet is limited to

## Brother HL-8e Fonts & Features

	HP LaserJet II											
	Helvetica	Times	Courier	Line printer	Helvetica	Times	Courier	Line printer	Helvetica	Times	Courier	Line printer
8.9-point	Bold	Italic	Sub-Super	Underline	Bold	Italic	Sub-Super	Underline	Bold	Italic	Sub-Super	Underline
10-point												
12-point												
14-point												
Scalable												

	IBM Proprinter XL			
	Bold	Italic	Sub-Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

The Brother HL-8e expands on the LaserJet emulation by adding proprietary Times and Helvetica fonts.

Courier, Courier Bold, and Line Printer fonts, the HL-8e offers Broughm (which is similar to Courier) in 10, 12, and 15 points, Letter Gothic in 8.5 points, Anelia PS (similar to Times Roman) in 12.5 points, BR-TMS (Times Roman) in 10 points, and BR-HLV (Helvetica) in 10 points. All of these typefaces are available in portrait and landscape orientation, in bold or medium weight, and in upright or italic format. The available character sets for each font include the standard LaserJet Roman-8 and the IBM character sets 1 and 2. Most of the fonts are not available to the printer's other emulations by software

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# BROTHER HL-8E



FACT FILE

EDITOR'S CHOICE

Brother International Corp., 8 Corporate Pl., Piscataway, NJ 08855-0159; (800) 284-2844, ext. 5337

List Price: \$2,895

Dimensions (HWD): 8.5 x 17.5 x 25.5 in.

Weight: 44 lbs

Emulations: Brother Twinlaser, Diablo 630, Epson FX-80, HPGL (7475A), HP LaserJet Series II, IBM Proprinter XL

In Short: This LaserJet II clone lives up to its promise: it matches LaserJet II behavior on all the PC Labs tests, using the same Canon engine as the LaserJet II to ensure good speed and good-looking output. The extras the HL-8e throws in make it slightly higher-priced than the LaserJet II, but well worth it.

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command, although you can select them from the printer's front panel. One nice bonus is that the HL-8e can accept font cartridges meant for the HP LaserJet.

The HL-8e is built around the same second-generation Canon engine found in the HP LaserJet II. Among other benefits, this construction makes setup and maintenance easy. To set up the printer, you unpack it, open the top, slip in the all-in-one toner and development cartridge, close the printer, and load some paper. Keeping the printer running consists primarily of replacing the cartridge every 4,000 to 5,000 pages.

The Canon engine is known for the quality of its output, and the HL-8e is true to form. Text output is superb in all emulations: dark, crisp, and clean, with none of the copier-quality look that still plagues many other laser engines. Furthermore, graphics output is also generally good. In PC Labs tests the cross-hatched areas, curved line, and scanned photo closely matched the capabilities of the printers being emulated. Alas, this also means that there are no improvements on the original. Some of the patterned areas in HP LaserJet emulation, for example, are nearly solid

black, as with the LaserJet itself.

The Canon engine is rated at 8 pages per minute. On the PC Labs text speed tests, the HL-8e clocked in at a respectable 7.4 ppm in LaserJet II mode. Text speed in Epson FX and IBM Proprinter XL emulations is a bit slower, at 7 ppm. Times on the graphics speed tests ranged from about 25 seconds in IBM Proprinter XL mode to about 31 seconds in HP LaserJet and Epson FX modes.

Paper handling is also a function of the base engine. The Canon SX has a 200-page paper tray, an adjustable manual feed suitable for paper or envelopes, and a face-down output bin. The printer also accommodates an alternative, straight-through path for envelopes and heavy paper.

The Brother HL-8e is a close twin to the LaserJet II, but is also a distinct improvement on it. Besides offering solid LaserJet II emulation using the same high-quality laser engine, it offers additional resident fonts and emulations. Even better, it offers these extras at about the same price. If you're looking at the LaserJet, you should seriously consider the HL-8e instead.

## Brother HL-8PS

by M. David Stone

The Brother HL-8PS is a close relative of both the HL-8, which won Editor's Choice last year, and the HL-8e, which is this year's improvement on the HL-8. As you might guess from the name, the HL-8PS is the PostScript version of the printer—though it also includes an HP LaserJet II emulation. All of which is a pretty good start for a \$4,495 printer.

Physically, the HL-8PS is essentially identical to its siblings. The control panel is similar: LEDs include a ready light, on-line indicator, data light, and an alarm light. You'll also find the typical laser printer one-line LCD and assorted membrane buttons.

The eight buttons on the control panel far outnumber the controls on most laser printers and even offer two functions in several cases. Among the choices are emulation (PostScript or HP mode), orientation (landscape or portrait), copy (for number of copies), and feeder (paper tray or manual feed slot). The sheer number of controls may be overwhelming at first, but they let you set the most important options with fewer menu levels, and, in any case,

you'll soon get used to them.

The HL-8PS performed well on PC Labs tests. On the PostScript tests, Brother's own BR-Script proved to be a dependable PostScript clone. The 35 resident fonts—using Brother's BR-Font—match the 35 standard PostScript fonts. In HP mode the printer breezed through the PC Labs torture test without a hitch.

A particularly nice touch in HP mode is that all of the printer's resident fonts are available to the HP emulation, using the appropriate HP font commands. Even better, because these are scalable fonts, the HP emulation can use any of the fonts in

### Brother HL-8PS

#### Fonts & Features

PostScript emulator							
Helvetica	Times	Courier	Line printer	Helvetica	Times	Courier	Line printer
Bold	Bold	Bold	Bold	Bold	Bold	Bold	Bold
Italic	Italic	Italic	Italic	Italic	Italic	Italic	Italic
Sub-Super	Sub-Super	Sub-Super	Sub-Super	Sub-Super	Sub-Super	Sub-Super	Sub-Super
Underline	Underline	Underline	Underline	Underline	Underline	Underline	Underline
8.9-point							
10-point							
12-point							
14-point							
Scalable							
HP LaserJet II							
Helvetica	Times	Courier	Line printer	Helvetica	Times	Courier	Line printer
Bold	Bold	Bold	Bold	Bold	Bold	Bold	Bold
Italic	Italic	Italic	Italic	Italic	Italic	Italic	Italic
Sub-Super	Sub-Super	Sub-Super	Sub-Super	Sub-Super	Sub-Super	Sub-Super	Sub-Super
Underline	Underline	Underline	Underline	Underline	Underline	Underline	Underline
8.9-point							
10-point							
12-point							
14-point							
Scalable							

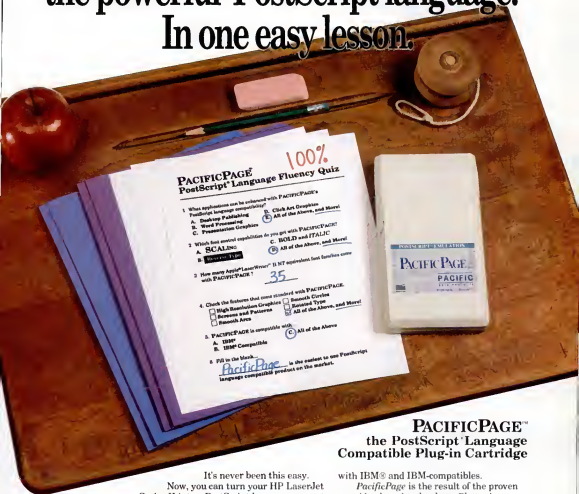
The Brother HL-8PS allows you to access all 35 PostScript fonts in the LaserJet mode.

any point size. In addition to Roman-8, the printer supplies the IBM character set 2 in U.S. and Danish versions.

One notable oversight is that the PC character set for the built-in fonts leaves out all of the graphics characters needed for building boxes and such. Depending on your applications, this may be an important drawback. However, Brother sells font cartridges for \$250 to \$600 that include the full IBM character set 2. The printer will also accept standard HP cartridges A through Z as well as downloadable PostScript fonts (note that the cartridges are strictly for HP mode). On-board memory for downloadable fonts is



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BASIC SYSTEM	\$1,439	\$1,139	\$1,139	\$1,139
20MB DRIVE	\$2,039	\$1,739	\$1,739	\$1,739
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BASIC SYSTEM 12MHz (True 12MHz CPU)

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20MB DRIVE	\$1,018	\$1,018	\$1,018	\$1,018
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100MB DRIVE	\$1,568	\$1,568	\$1,568	\$1,568

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## PRINTERS LASER PRINTERS

### BROTHER HL-8PS



### PC FACT FILE EDITOR'S CHOICE

Brother International Corp., 8 Corporate Pl.,  
Princeton, NJ 08855-0159; (800) 284-2844  
ext. 5337  
List Price: \$4,495  
Dimensions (HWD): 8.5 x 17.5 x 25.5 in.  
Weight: 44 lbs  
Emulations: BR-Script, HP LaserJet Series II  
In Short: The Brother HL-8PS offers  
compatibility with both PostScript and the HP  
LaserJet Series II at a fair price. All the scalable  
fonts in Brother's PostScript emulation are  
available to the LaserJet mode in any port size.  
And the second-generation Canon engine  
ensures high-quality output.

CIRCLE 396 ON READER SERVICE CARD

placed every 4,000 to 5,000 pages.

Without question, the Brother HL-8PS is a winner. As a PostScript clone, it offers as much as the original, with no noticeable loss in features or quality. In its HP mode, it offers all the features of the original, with scalable fonts thrown in for good measure. The lack of a complete IBM character set 2 is a minor impediment. But at a list price of \$4,495, the HL-8PS is a worthy addition to the Brother family even without the graphics characters.

## Camintonn TurboLaser/PS-Plus 3

by M. David Stone

If you're having trouble deciding between a PostScript printer and one that does HP LaserJet II emulation, you might be interested in Camintonn Corp.'s TurboLaser/PS-Plus 3, which does both. For those who need only PostScript and who find the \$5,695 price too dear, Camintonn's PostScript-only version, the TurboLaser/PS, is \$900 less. But the PS-Plus 3 is not just expensive—it has a few rough edges as well.

Print quality on the PS-Plus 3 is dark and crisp, thanks to the Ricoh LP4081 engine. But be aware that text quality is not quite a match to the output from a LaserJet II; the characters in the Courier typeface are just a bit thinner than they should be. However, graphics output in PostScript mode is superb.

Setting up the PS-Plus 3 is reasonably straightforward. You simply install the input and output paper trays, empty two toner cartridges into a toner bin, and drop the optical photo conductor cartridge into position.

A noteworthy asset is flexibility in the choice of connectors. The rear panel sports three: a DB-9 for either AppleTalk or serial connection, a DB-25 for serial connection only, and a 36-pin Centronics connector for parallel connection. A clearly labeled rotary switch lets you choose among them. Connecting the printer is as easy as plugging in your choice of cable and turning the switch to the appropriate setting.

Oddly, the only front-panel control is the on-line/off-line switch. To change emulations, set baud rate, or issue any other command to the printer, you must first create a file that contains escape codes, then print the file or copy it to the printer. Un-

fortunately, this approach will be new to many users, and the manual does not give the detailed explanation you'll need if you don't already understand the technique.

The PS-Plus 3 includes two additional emulations: Diablo 630 ECS and DEC LN03. Neither of these is important for most DOS users. However, Diablo 630 emulation may come in handy if you have software that predates PostScript and HP LaserJet printers.

Unfortunately, the printer always wakes up in LN03 emulation. This means you have to copy a file to the printer every time you turn it on. The obvious solution is

### Camintonn TurboLaser/PS-Plus 3 Fonts & Features

	PostScript				HP LaserJet II			
	Helvetica	Times	Courier	Line printer	Helvetica	Times	Courier	Line printer
Bold	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Italic	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Underline	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sub-Super	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
8.5-point	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
10-point	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
12-point	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
14-point	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
16-point	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Scalable	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

The Camintonn TurboLaser/PS-Plus 3 uses Adobe PostScript fonts, which are accessible in LaserJet mode.

to include a copy command in your AUTOEXEC.BAT file, but then you have to make sure that the printer is on and ready before you boot up your computer. According to Camintonn, the next revision of firmware (Version X.10) will let you change the default emulation. The new firmware should be shipping by the time this issue hits the newsstands.

There's one problem that the new firmware won't solve: the printer gives no indication when it is receiving data. This means that when printing a time-consuming graphic, for example, you have no way of knowing if the graphic is still in progress or if your system has just crashed.

2MB standard, expandable to 6MB.

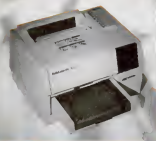
Because print quality is largely dependent on the printer engine, and because the HL-8PS uses the same engine as both the LaserJet II and the Apple LaserWriter II, it's no surprise that the HL-8PS can match either of those printers for both text and graphics quality. Output is excellent, with graphics retaining details and shading appropriate for each emulation. Text output is a match for any 300-dot-per-inch laser printer.

Text speed is also pretty much as expected for the Canon engine. On PC Labs text speed tests, the printer scored 7.4 pages per minute both in PostScript mode and in HP mode. Graphics speed came out to about 32 seconds for HP mode and an acceptable 5 minutes 9 seconds for PostScript mode.

Setup and maintenance is yet another positive aspect of the underlying engine. One of the nicer features of the Canon SX is the all-in-one cartridge for toner and drum. To set up the Brother HL-8PS, just remove the packing materials, then load the cartridge and paper, finally connect the power cord and computer, and go. You should note that the cartridge must be re-

# PRINTERS LASER PRINTERS

## CAMINTON TURBOLASER/ PS-PLUS 3



### PC MAGAZINE FACT FILE

Camintonn Corp., 2332A McGraw Ave., Irvine, CA 92714-4992; (714) 553-0247.

List Price: \$5,695

Dimensions (HWD): 15 x 20.25 x 23.5 in

Weight: 81 lbs

Emulations: DEC LN03, LN03R, LN03 Plus; Diablo 630 ECS; HP LaserJet Series II; PostScript

In Short: If you need an HP LaserJet II as well as a PostScript printer, Camintonn wants you to have it both ways. The PS-Plus 3 offers both emulations, with DEC LN03 and Diablo 630 ECS thrown in for good measure. PC Labs found some flaws in the printer sent for review, but Camintonn claims to have fixed most of them with new firmware.

CIRCLE 401 ON READER SERVICE CARD

As a PostScript printer, the PS-Plus 3 offers few surprises. It comes with the 35 standard Adobe (yes, genuine Adobe) fonts built in, has the expected nonprinting areas of 0.2 inches to 0.3 inches on each margin, and obeys PostScript commands well enough to print the PC Labs text and graphics samples. Alas, the printer has at least one flaw in its PostScript personality. One of the PC Labs PostScript tests polls the printer for current fonts and other information, then prints a status sheet. The PS-Plus 3 would not print the sheet.

LaserJet II emulation is also less than exact, but at least one difference is a clear improvement over the LaserJet II. Rather than being limited to Courier, Courier Bold, and Line Printer, the PS-Plus 3 can use all PostScript fonts—including any downloaded fonts—while in LaserJet mode. The sacrifice you'll have to make for this feature is that the printer cannot accept LaserJet downloadable fonts.

On the LaserJet graphics speed test, the printer crashed so convincingly that it had

to be turned off and on before it could print again. A call to Camintonn confirmed this as a bug. According to a company representative, the problem has been fixed in the new firmware. In other LaserJet emulation tests, the printer behaved pretty much as it should. On PC Labs text speed tests, the printer managed an unremarkable 6.5 pages per minute for PostScript mode and 6.3 ppm for LaserJet emulation. On the graphics speed test, it clocked in at a slow though not unreasonable 15 minutes, 47 seconds in PostScript mode.

As tested, the Camintonn TurboLaser/PS-Plus 3 clearly has serious deficiencies, most of which Camintonn claims to have already fixed. But even allowing for the new firmware, the printer still suffers from such oversights as its insufficient front-panel controls, lack of a data receive indicator, and its sometimes spotty manuals. For \$5,695, you're better off looking elsewhere.

## Canon LBP-8 Mark III

by M. David Stone

In a world dominated by the HP LaserJet, Canon seems to have decided: if you can't join 'em, beat 'em. Where other manufacturers build LaserJet-compatible printers, Canon has chosen to go its own way. The result has been a series of Canon printers that are consistently as good as or better than, but always slightly different from, the same-generation LaserJet. The \$2,995 LBP-8 Mark III is the latest in that series.

The Mark III is built around the same 8-page-per-minute Canon engine that you'll find in the HP LaserJet II and the Canon LBP-8 II. Among the benefits of that engine are its speed and print quality. Its performance in the Mark III is true to form, at 47 seconds on the PC Labs graphics speed test and 7.3 ppm on the text speed test—in both cases, a tad slower than the LaserJet IID reviewed in this issue. Print quality is superb: text is dark and crisp, and graphics are even better.

On the PC Labs graphics speed test, the Mark III retained far more detail in the scanned photo than most other printers, and it yielded finer distinctions than the LaserJet II. Apparently, Canon knows some secrets about controlling its engine that HP has yet to learn, and it has incorpo-

rated that knowledge into the Canon Printer System Language (CaPSL).

The Mark III's most interesting new feature is a suite of nine built-in scalable fonts. These include three typefaces: Dutch (Times Roman), Swiss (Helvetica), and Symbol. Dutch and Swiss come in medium, medium italic, bold, and bold italic. Symbol matches the PostScript Symbol typeface and includes such hard-to-find characters as the three-dot symbol for "therefore" that you learned in high school geometry. And, if nine scalable fonts aren't enough for you, Canon offers a \$295 font card with 22 additional scalable

## Canon LBP-8 Mark III Fonts & Features

Canon LBP-8 Mark III											
	Helvetica	Times	Courier	Line printer							
	Bold	Italic	Sub-Super Underline	Bold	Italic	Sub-Super Underline	Bold	Italic	Sub-Super Underline	Bold	Italic
8 1/2-point											
10-point											
12-point											
14-point											
Scalable											
Diablo 630											
	Helvetica	Times	Courier	Line printer							
	Bold	Italic	Sub-Super Underline	Bold	Italic	Sub-Super Underline	Bold	Italic	Sub-Super Underline	Bold	Italic
8 1/2-point											
10-point											
12-point											
14-point											
Scalable											

The Canon LBP-8 Mark III offers nine built-in fonts that are scalable from 1 to 27 points.

fonts—giving you very nearly the same font choices as a typical PostScript printer (minus Palatino and a scalable Courier) for just under \$3,300 list price.

The scalable fonts work much as they do in a PostScript printer. You can specify any size between 1 and 127 points, and any orientation. In addition, you can modify each font with such enhancements as outline, shadow, fill (with a pattern), shading (with the background shaded), reverse printing (black background with white text), and various combinations of these, such as outline plus shadow.

When using the scalable fonts, the LBP-8 Mark III generates characters on

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 1.2MB 5.25" or 1.44MB 3.5" Floppy Drive  
 Ports: 1 Serial, 1 Parallel, 1 Game  
 Clock Calendar with Battery Backup  
 8 Expansion Slots: one 32-Bit, five 16-Bit, two 8-Bit  
 5 Drive Bays - 3 Exposed, 2 Internal  
 200 Watt ASTEC Power Supply  
 Enhanced 101-Key Keyboard

#### Model 325

Intel 80386-25 CPU running at 25/8 MHz  
 Benchmark v1.1 = 41.5 MHz  
 1MB of 32-Bit RAM expandable to 16MB  
 Intel 82385 Cache Controller with 32KB Static RAM  
 Shadow RAM Option for Video and BIOS included  
 Intel 80387-25 and WEITEK 3167 Socket  
 Dual Floppy/ Dual Hard Drive Controller with L1 Interface  
 1.2MB 5.25" or 1.44MB 3.5" Floppy Drive  
 Ports: 1 Serial, 1 Parallel, 1 Game  
 Clock Calendar with Battery Backup  
 8 Expansion Slots: one 32-Bit, five 16-Bit, two 8-Bit  
 5 Drive Bays - 3 Exposed, 2 Internal  
 200 Watt ASTEC Power Supply  
 Enhanced 101-Key Keyboard

#### Model 320

Intel 80386-20 CPU running at 20/8 MHz  
 Benchmark v1.1 = 33.4 MHz  
 1MB of 32-Bit RAM expandable to 16MB  
 Intel 82385 Cache Controller with 32KB Static RAM  
 Shadow RAM Option for Video and BIOS included  
 Intel 80387-20 and WEITEK 3167 Socket  
 Dual Floppy/ Dual Hard Drive Controller with L1 Interface  
 1.2MB 5.25" or 1.44MB 3.5" Floppy Drive  
 Ports: 1 Serial, 1 Parallel, 1 Game  
 Clock Calendar with Battery Backup  
 8 Expansion Slots: one 32-Bit, five 16-Bit, two 8-Bit  
 5 Drive Bays - 3 Exposed, 2 Internal  
 200 Watt ASTEC Power Supply  
 Enhanced 101-Key Keyboard

#### Model 316

Intel 80386-16 CPU running at 16/8 MHz  
 Benchmark v1.1 = 20.1 MHz  
 1MB of 32-Bit RAM expandable to 16MB  
 Shadow RAM Option for Video and BIOS included  
 Intel 80287-8 Math Co-Processor Socket  
 Dual Floppy/ Dual Hard Drive Controller with L1 Interface  
 1.2MB 5.25" or 1.44MB 3.5" Floppy Drive  
 Ports: 1 Serial, 1 Parallel, 1 Game  
 Clock Calendar with Battery Backup  
 8 Expansion Slots: one 32-Bit, five 16-Bit, two 8-Bit  
 5 Drive Bays - 3 Exposed, 2 Internal  
 200 Watt ASTEC Power Supply  
 Enhanced 101-Key Keyboard

#### Model 333 Hard Drive Capacity

Video Combs	60MB ESDI	90MB ESDI	150MB ESDI	320MB ESDI
14" MONO	\$ 2800	\$ 4349	\$ 4603	\$ 5149
14" EGA	\$ 4143	\$ 4689	\$ 4943	\$ 5489
14" VGA	\$ 4285	\$ 4831	\$ 5085	\$ 5631

#### Model 320 Hard Drive Capacity

Video Combs	60MB ESDI	90MB ESDI	150MB ESDI	320MB ESDI
14" MONO	\$ 2503	\$ 3049	\$ 3303	\$ 3849
14" EGA	\$ 2843	\$ 3389	\$ 3643	\$ 4189
14" VGA	\$ 2985	\$ 3531	\$ 3785	\$ 4331

#### Model 325 Hard Drive Capacity

Video Combs	60MB ESDI	90MB ESDI	150MB ESDI	320MB ESDI
14" MONO	\$ 3103	\$ 3649	\$ 3903	\$ 4449
14" EGA	\$ 3843	\$ 4389	\$ 4643	\$ 5189
14" VGA	\$ 3985	\$ 4531	\$ 4785	\$ 5331

#### Model 316 Hard Drive Capacity

Video Combs	60MB ESDI	90MB ESDI	150MB ESDI	320MB ESDI
14" MONO	\$ 2203	\$ 2749	\$ 3003	\$ 3549
14" EGA	\$ 2543	\$ 3089	\$ 3343	\$ 3889
14" VGA	\$ 2685	\$ 3231	\$ 3485	\$ 4031

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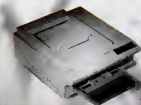
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## PRINTERS LASER PRINTERS

### CANON LBP-8 MARK III



### PC FACT FILE

Canon USA Inc., Printer Division, One Canon Plaza, Lake Success, NY 11042; (516) 488-6700.  
List Price: \$2,995  
Dimensions (HWD): 8.5 x 17.75 x 25.5 in.  
Weight: 45.5 lbs.  
Emulations: GCPSL II, Diablo 630  
In Short: Nine built-in scalable fonts, superb print quality, and an upcoming PostScript-compatible option on a plug-in cartridge are just three of the features that make the Canon LBP-8 Mark III worth serious attention. Also, you still won't find HP compatibility in the Canon line, but Canon's newfound support among major software houses may make up for that.

CIRCLE 408 ON READER SERVICE CARD

the fly, by way of its built-in 32-bit National Semiconductor NS32C16 microprocessor. A font cache feature uses the printer's RAM to store the most recently generated fonts, so they can be reused without needing to be regenerated. The printer comes with 1.5MB minimum RAM, expandable to 4.5MB.

In addition to its scalable fonts, the Mark III has several bitmapped Courier fonts: 10-pitch medium, bold, italic, and 15-pitch medium—the equivalent of Line Printer in the HP. The bitmapped fonts are included in both portrait and landscape orientations. Canon also sells three cards with bitmapped fonts to provide full software compatibility with the LBP-8 II. If you already have an LBP-8 II, however, you can't use your old font cartridges in the Canon III's two slots. The company says it switched to the new cards because the new cards can hold more fonts than the old cartridges.

Of course, none of these features will do much good unless you have software to support them. In the past, Canon printers have suffered from lack of widespread support. The company has been working to change this situation. According to Canon, support for the Mark III is solid: application heavyweights such as Micro-

soft, WordPerfect, and Lotus are among the companies that have promised Mark III drivers for roughly 50 packages. Especially interesting, considering the printer's potential for desktop publishing, are forthcoming drivers for GEM as well as for Windows 2.1.

For those packages that don't have specific drivers for the Mark III, the printer will act like an LBP-8 II for text and graphics. If all else fails, you can fall back on the built-in Diablo 630 ECS emulation. Canon has also promised plug-in card options for IBM Proprinter and DEC LN03 Plus emulations. And a plug-in Adobe PostScript option is due out by the end of 1989 at a price not yet determined.

If the LBP-8 Mark III sounds appealing, check before buying to make sure that the features you most want are fully supported in your favorite software. As it stands now, the Mark III is an intriguing printer with a lot of potential. If Canon delivers on all its promises—or even most of them—the printer may well become a clear winner.

## Desktop Laser Beam

by Tony Rizzo

Desktop Systems' Desktop Laser Beam is a simple model that does one thing and does it well. But its \$1,995 price doesn't just buy solid HP LaserJet Series II emulation. You'll get 512K RAM and software that includes *LaserPlotter*, a multiplotter emulation package. And that's not all—132 Bistream soft fonts are thrown into the deal.

Desktop Systems is a subsidiary of Everex and sells the Desktop Laser Beam printer directly to dealers. The basic printer is manufactured by Tokyo Electronics Corp. (TEC), which is also responsible for designing and building the printer's engine.

Although not exactly a well-known entity, the TEC engine served as the foundation for four other printers reviewed here: the Epson EPL-6000, the Mannesman Tally 905, the NCR 6435, and Spear Technology's Desktop Laser Printer. All five offer high-quality output at a little faster than 5 pages per minute on the PC Labs test speed test. At prices ranging from \$1,355 for Spear's model, to \$2,395 for NCR's, these TEC-based printers are just about the least expensive lasers around. Besides

their price tags and slight speed differences, what differentiates these printers from each other is the caliber of their LaserJet emulations. Some coasted through our PC Labs torture tests without a bump, while others crashed on macros.

The Desktop Laser Beam's HP LaserJet Series II emulation performed flawlessly. The printer's three resident fonts are the typical Courier, Courier Bold and Line Printer. The Laser Beam also supports the 256-character set, allowing each font to provide four different symbol sets, the IBM graphics set among them. Fonts are selectable directly from the front panel.

Setting up the printer takes less than 5 minutes from box to startup: you can hook it up either through a standard Centronics

### Desktop Laser Beam Fonts & Features

HP LaserJet II		Courier		Line printer	
Helvetica	Times				
Bold	Sub-Super Underline	Bold	Sub-Super Underline	Bold	Sub-Super Underline
8.5-point					
10-point					
12-point					
14-point					
Scalable					

The Desktop Laser Beam comes with Bistream fonts but also accepts HP-compatible font cartridges and soft fonts.

8-bit parallel port or through a serial RS-232C/RS-422A connection.

Print quality is very good and will certainly satisfy most users' needs. The TEC engine doesn't seem quite up to Canon in quality, but it's close. In text speed tests, the Laser Beam scored at just under its 6-page-per-minute rating.

The printer comes standard with 512K of memory, expandable to 4.5MB. According to Desktop Systems, the Desktop Laser Beam is also compatible with the Everex PostCard Plus, a \$1,795 board with 35 resident Bistream fonts and 3MB of on-board memory for PostScript compatibility. If you think PostScript might be in your future, this board is a terrific option.

The control panel is divided into two sections. The first has the usual on-line/off-line, reset/continue, and manual feed switches, as well as a paper mode switch that adjusts the printer to standard or heavy-



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TOP CHOICE

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AUGUST, 1989

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COMPUTE'S PC MAGAZINE,  
SEPTEMBER, 1989

"The amount of software included with the HeadStart III is amazing ... a system with software and hardware extras that far outweigh its price tag."

INFOWORLD  
AUGUST, 1989

"The HeadStart III is about as close to a no-hassle PC as I've seen."

LOS ANGELES TIMES,  
NOVEMBER 24, 1988

"If it sounds like we're raving about this machine we are."

COMPUTER BUYERS  
GUIDE, 1989



"...It's hard to imagine a better choice."

PC WORLD,  
JUNE, 1989

"Using a HeadStart III is almost as easy as plugging it in."

COMPUTER WORLD  
MAGAZINE, MAY, 1989

## SPECIFICATIONS

**MICROPROCESSOR:** Intel 80386-15  
**SPEED:** 12 MHz/19 Swatchels  
**BUS:** Bus  
**BUILT IN RAM:** 1 megabyte  
**EXPANDABLE TO:** 2 megabytes  
**POWER SUPPLY:** 140 watts  
115-220 switchable  
**KEYBOARD:** 83 key PS/2 compatible  
**GRAPHICS:** VGA Automatic  
**FLUPPY DRIVE:** one 5.25" 1.2 megabyte and 3.5" 1.44 megabyte  
**HARD DRIVE:** 20.1 megabyte, 20 megabyte, 1.1 megabyte  
**BUILT IN INTERFACES:** Parallel 2-MS/25 serial mouse joystick  
**EXPANSION BUSES:** 3 available  
**MOUSE:** Standard  
**SOFTWARE:** DOS 3.3 G/W Basic, HeadStart Advanced Environment, Flight Driver, Framework II 3-D Graphics API, and Computer-4/5 case Tutorial Software, three hard disk manager Publish or Perish 2860 Splash VGA paint program, Bookman, plus Text and Sheet



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## DESKTOP LASER BEAM

PC  
MAGAZINE  
FACT FILE

Desktop Systems Inc., 48431 Milmont Dr., Fremont, CA 94538, (800) 444-5321, (415) 683-2727 or 4723.

List Price: \$1,995; optional PostScript board, \$1,795; Diablo 630, Epson FX-80 Plus, IBM Proprinter XL in emulation cartridges, \$199 each. Dimensions (HWD): 8.25 x 16.5 x 24.75 in. Weight: 35.3 lbs.

Emulations: Resident: HP LaserJet Series II; on-disk: Diablo 630, Epson FX-80 Plus, Epson MX-80, IBM Proprinter XL, NEC 3550, NEC 5510, NEC 7710, Qume Sprint 5.

In Short: A simple, straightforward HP LaserJet II clone that gets the job done. The printer comes with 132 HP-compatible soft fonts from Bitstream; you can also buy optional emulation cartridges. Overall, an excellent buy deserving serious consideration.

CIRCLE 423 ON READER SERVICE CARD

er stock paper. The second section is a bit more complicated and allows front-panel control of a variety of functions. These include selecting internal, cartridge, or soft fonts, setting paper size, toggling the warning buzzer on/off, and selecting an emulation. Unfortunately, the membrane switches don't always respond to touch, often requiring three or four presses.

Add up the Desktop Laser Beam's 132 bundled soft fonts and top-flight HP LaserJet compatibility, and you've got an excellent deal at less than \$2,000. If you're looking for simplicity at a fair price, take a closer look at this one.

## Epson EPL-6000

by Bruce Brown

Epson hasn't had a page printer on the market for a while, but the company's new laser printer, the EPL-6000, is a welcome addition. Based on Tokyo Electric Corp.'s 6-page-per-minute laser engine, this \$1,899 page printer is well priced and well positioned to give the HP LaserJet Series II a close race.

The EPL-6000's standard emulation is

the HP LaserJet II, including the HP's standard Courier, Courier Bold, and Line Printer fonts in both portrait and landscape orientations. While you give up extra resident fonts with printers that are true HP compatibles, the EPL-6000 goes further than many with its compatibility: it's able to use stock HP or third-party plug-in font cartridges, as well as downloaded soft fonts. Our testing showed the EPL-6000 to be entirely faithful to the HP standard, unlike some of the other TEC-based printers reviewed here.

If you run software that doesn't recognize the HP, or if you're just an Epson loyalist, you can buy an Epson FX series emulation cartridge for \$129—not a bad price for extending your software compatibility reach as wide as the FX extends. Still, Epson would do well to include this cartridge with the printer; the extra value might help to distinguish this model from others in this price range.

The EPL-6000 is a modern-looking smallish unit, measuring 8.25 by 24 by 16 inches (HWD with the paper cassette attached) and weighing 36 pounds. Parallel Centronics and 25-pin serial interfaces are both standard.

A simple selector lets you choose between facedown and faceup paper delivery. The exit tray for the straight-through paper path is clumsy-looking but effective. The standard paper cassette can hold up to 150 sheets of legal- or letter-size paper. You can also feed single sheets or envelopes manually from the top of the cassette without removing it from the printer, a convenient arrangement similar to that

## EPSON EPL-6000

PC  
MAGAZINE  
FACT FILE

Epson America Inc., 2780 Lomita Blvd., Torrance, CA 90505, (800) 922-8911. List Price: \$1,899; Epson FX emulation cartridge, \$129.

Dimensions (HWD): 8.25 x 24 x 16 in. Weight: 36 lbs.

Emulations: Hewlett-Packard LaserJet Series II. In Short: Epson's new HP LaserJet Series II-compatible laser printer is an attractive, low-cost, 6-ppm page printer alternative from a major printer vendor. Add Epson FX series compatibility for a mere \$129, and you have the best of both worlds. With its deep dealer discounting, you're likely to find that this printer can be a very good buy.

CIRCLE 427 ON READER SERVICE CARD

used by Hewlett-Packard.

The EPL-6000 scored a respectable 5.4 ppm on PC Labs text speed tests. Character and graphics printing resolution were both fine, though not as dark as with the HP LaserJet II. There's a simple dial to increase print density, but even with the dial cranked all the way up, the blacks weren't quite black.

Standard memory on the EPL-6000 is 512K. An \$899 optional memory board adds an extra 2MB; that board can be upgraded to a max of 4MB with third-party memory chips from Toshiba, Okidata, or Motorola.

The EPL-6000's control panel, located on a forward-canted protrusion on the case front, uses membrane buttons, LED indicators, and a 16-character LCD display. Epson calls its panel-controlled menu system "SelectType," just as it does with its dot matrix printers. Using the menu system is straightforward; it's especially easy if you use the manual or the convenient quick reference card.

One problem with Tokyo Electric Corp.'s laser engine is that you have to mess with several consumable supplies. However, installing and then replacing consumable supplies isn't tough at all with the EPL-6000—everything fits well and

## Epson EPL-6000

## Fonts &amp; Features

	HP LaserJet II				Courier				Line printer			
	Helvetica	Times	Courier	Line printer	Helvetica	Times	Courier	Line printer	Helvetica	Times	Courier	Line printer
8-9-point	Bold	Italic	Superscript	Underline	Bold	Italic	Superscript	Underline	Bold	Italic	Superscript	Underline
10-point												
12-point												
14-point												
Scalable												

The Epson EPL-6000 accepts HP-compatible font cartridges and soft fonts.

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Inverted Foldout slip-sheet

Folded edge of the page

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2. Insert this sheet with

1. Front side touching the free page
2. Arrow pointing to the fold



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4. Close the page and slip-sheet

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Inverted Back



Gbs5tpBack-0018

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locks in easily. Toner cartridges cost just \$29. According to Epson, the first is good for just 750 pages, but subsequent cartridges are rated at 1,500 sheets each. Every 10,000 pages, you must replace the photoconductor drum and charger unit, which together cost \$149.

The EPL-6000 is designed to print 3,000 sheets a month. The total life expectancy is 5 years or 300,000 sheets, whichever comes first.

I like the Epson EPL-6000. It was easy to set up and ran just as expected, yielding true HP emulation. The lack of absolute blacks is its only drawback. The EPL-6000 should compete well with similarly equipped printers because of its name recognition, wide dealer and service center network, and the possibility of increasingly deeper discounts. So in the end, your choice is between Epson's model and the HP original. You'll pay a few hundred dollars more for HP, but the extra dollars will buy you higher speed and the proven favorite. But don't forget Epson's FX emulation when making your choice—if you need it, you can't get it from HP yet.

## Fortis DP600P

by Bruce Brown

While some vendors—such as Brother and Camintonn—are offering combined PostScript- and HP LaserJet II-compatible printers, Fortis Information Systems keeps them separate in two similar models.

Fortis's \$4,499 DP600P PostScript compatible shares much with the DP600S (also reviewed here). In terms of construction, size, and weight, the Fortis DP600P is identical to its non-PostScript sibling. The DP600P breaks away from the DP600S's mold with a 32-bit, 4-mips Weitek RISC raster image processor to handle the PostScript-compatible page description language code, which is stored in 1.5MB of ROM chips. The additional 3MB of user-accessible RAM is 1MB more than the absolute minimum 2MB for PostScript-like printers, but users who need 4MB will be disappointed: the DP600P has no memory expansion options. The PostScript emulator used in the DP600P is the Qume CrystalPrint Publisher, Revision 2.02.

Rated at 6 pages per minute, the DP600P scored slightly above spec at 6.01 ppm in the PC Labs text speed test. Its speed on the graphics speed test was even more impressive. Emulating an Apple

### Fortis DP600P

## Fonts & Features

	Helvetica	Times	Courier	Line printer
Normal	✓	✓	✓	✓
Italic	✓	✓	✓	✓
Underline	✓	✓	✓	✓
8.5-point	✓	✓	✓	✓
10-point	✓	✓	✓	✓
12-point	✓	✓	✓	✓
14-point	✓	✓	✓	✓
Scalable	✓	✓	✓	✓

The Fortis DP600P comes with the standard 35 PostScript fonts.

LaserWriter II, the DP600P printed the graphics speed test image in just 111 seconds, which is actually better than many 8-ppm-rated printers.

No other printer emulations are available, nor are any font cards for sale. The DP600P comes with the standard Post-

Script panoply of 35 fonts. The basic font types include Courier, Dutch, ITC Avant Garde Gothic, ITC Bookman, New Century Schoolbook, Swiss, Symbol, Zapf Calligraphic, Zapf Chancery, and Zapf Dingbats, the latter a collection of symbols and graphics elements.

The DP600P has four standard interfaces. In addition to the standard parallel Centronics and DB-25 RS-232 serial interface ports, it has an AppleTalk port. As on the DP600S, the DB-25 serial port can be set to operate as an RS-422 serial device port.

Small, inexpensive, fast: the Fortis DP600P has the right formula for a PostScript-compatible printer. And with 3MB of standard RAM, the deal looks even better. If you needs run to desktop publishing and both your wallet and your desktop are small, take a second look at the Fortis DP600P.

## Fortis DP600S

by Bruce Brown

For \$2,500 less than the DP600P, Fortis offers its DP600S, an HP LaserJet II-compatible liquid-crystal-shutter page printer that sells for \$1,999. Like its higher-priced sibling, the DP600S won't bury your budget or throw any unwanted surprises in your direction.

The DP600S is a pretty good deal. The list price includes a toner unit with three toner cartridges—good for a rated total of 6,000 printed pages—as well as a 6,000-page drum set and a 100-sheet letter-sized paper tray. A replacement toner kit costs \$99, and a new drum lists for \$129, so plan on spending \$228 on supplies every 6,000 pages or so. According to Fortis, some users find they don't have to replace the photoconductive drum until a full 10,000 pages have been printed, stretching the deal even further.

The page-printing engine in the DP600S is a Casio liquid-crystal-shutter (LCS) dry electrophotography system rated at 6 pages per minute, with a maximum resolution of 300 by 300 dots per inch. Emulating the LaserJet II, the DP600S scored 5.8 ppm on the PC Labs text speed test—very close to the design rating and only a page or so slower than the actual performance of many 8-ppm-rated page printers.

The DP600S is a true LaserJet II compatible, with no resident fonts added to the LaserJet's sparse Courier Bold and Medi-



**PC FACT FILE**

Fortis Information Systems Inc., 6070 Rickenbacker Rd., Commerce, CA 90040; (213) 727-1227.  
 List Price: \$4,499  
 Dimensions (HWD): 9.25 x 15.5 x 13.5 in.  
 Weight: 35 lbs.  
 Emulations: Apple LaserWriter II, PostScript, In Sheets: The Fortis DP600P is a PostScript-compatible Casio-engine page printer rated at 6 ppm. With 35 resident fonts, 3MB of RAM, and 1.5MB of ROM, the DP600P is well equipped and doesn't take up lots of space. The DP600P slightly exceeded its rating in our speed tests and, at \$4,499, is a good value.

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## PRINTERS LASER PRINTERS

um and its Line Printer typefaces; it is capable of printing in both portrait and landscape orientation. As with the HP unit, the DP600S can use optional font cartridges, although it is not plug compatible with actual HP cartridges. Six single-font cartridges offer typefaces that correspond to HP fonts; they are available for \$139 each, and a two-font Microsoft cartridge (compatible with the HP Z cartridge) costs \$239.

This Fortis printer can accept emulation

cards to add compatibility with other printers—something HP machines can't do yet. Emulation cards for Epson FX, IBM Proprinter, and HPGL (HP 7475A Plotter-compatible) identities cost a reasonable \$139 each. A Diablo 630 emulation card costs a mere \$79, probably in response to reduced demand.

The Fortis prints beautifully as a char-

### Fortis DP600S

## Fonts & Features

	HP LaserJet II							
	Helvetica		Times		Courier		Line printer	
	Real	Sub-Raster	Real	Sub-Raster	Real	Sub-Raster	Real	Sub-Raster
80-point								
10-point								
12-point								
14-point								
Scalable								

Font cartridges, starting at \$139, are available for the Fortis DP600S.

acter printer, outputting fully formed high-resolution type. The resolution of graphics output was fine as well, but the blacks weren't as dark as expected. The Fortis printed our HP-compatibility torture test quickly and without a hitch. The DP600S

### FORTIS DP600S



## PC MAGAZINE FACT FILE

Fortis Information Systems Inc., 6070 Rickenbacker Rd., Commerce, CA 90040; (213) 727-1227.

List Price: \$1,999; Epson FX-85, IBM Proprinter, and HPGL emulation cartridges, \$139 each; Diablo 630 emulation cartridge, \$79.

Dimensions (HWO): 9.25 x 15.5 x 13.5 in.

Weight: 35 lbs.

Emulations: Hewlett-Packard LaserJet Series II in Short; The Fortis DP600S is rated at 6 ppm and offers HP LaserJet Series II compatibility for less than \$2,000 list. The small-footprint DP600S works well, though its blacks were a bit gray. The lack of other standard emulations or more than bare-bones HP fonts makes the DP600S less competitive than some other page printer alternatives.

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\$100	Laser Label Software		
<b>Laser Transparencies</b>			
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\$292	8 1/2" x 11"		20
<b>Return Address Labels</b>			
\$267	10" x 1 1/2"	80	25
<b>Address/Shipping Labels</b>			
\$160	1" x 2 1/2"	30	100
\$161	1" x 4"	20	100
\$162	1 1/2" x 4"	14	100
\$163	2" x 4"	10	100
\$164	3 1/2" x 4"	6	100
\$165	8 1/2" x 11"	1	100
<b>Laser Diskette Labels</b>			
\$196	2 1/4" x 2 1/4"	9	70
for 5 1/4" diskettes			
\$296	3 1/2" x 5 1/8"	12	70
for 5 1/4" diskettes			
<b>Laser File Folder Labels</b>			
\$296	9 1/2" x 3 1/8"	30	25
<b>Round Laser Labels</b>			
\$293	1 1/2"	24	25
\$294	2 1/8"	12	25
\$295	3 1/8"	6	25

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LaserJet Series II

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# PRINTERS LASER PRINTERS

was no slouch in graphics mode on speed tests, either; it printed the PC Labs graphics test image in just over 36 seconds.

The DP600S comes standard with both a parallel Centronics interface and a 25-pin serial interface. The serial interface port can also be set to work as an RS-422 port, effectively doubling the maximum data-transfer speed.

The control panel on the DP600S consists of a two-character display screen for status and error messages, five membrane

**The Fortis DP600S**  
comes standard with a  
parallel Centronics  
interface and a 25-pin  
serial interface,  
which can work as an  
RS-422 port.

switches to perform form feeds and to select and execute printer-menu function settings, as well as six indicator lights. Two-character status codes seem primitive in a world of 16-character LCD displays, but it's easy to get accustomed to the few codes used on the Fortis DP600S.

The standard letter-size paper cassette can be augmented or replaced by legal-size as well as DIN B5 and A4 paper cassettes; these optional cassettes cost \$69 each.

Like the HP LaserJet, the Fortis DP600S comes standard with 512K of memory, enough for normal page printing but not enough for a full page of 300- by 300-pixel resolution graphics. If you're going to do a lot of graphics work, you may want to consider the \$499 1MB memory upgrade, which raises the total memory to 1.5MB.

Measuring just 9.25 by 15.5 by 13.25 inches (HWD) with the paper tray installed, the DP600S won't encroach much on your crowded desk. Although it isn't particularly light, at 35.2 pounds the DP600S isn't a back-straining heavy-weight, either.

Apart from the lightness of black areas in the graphics printing samples, the Fortis

DP600S is a satisfying HP LaserJet Series II-compatible printer. But at \$1,999, the price is not quite aggressive enough—there are other clone printers at similar price points with extra emulations and fonts already resident. After all, the original LaserJet lists for just \$700 more and is widely discounted.

The Fortis DP600S is a praiseworthy printer indeed, but it needs something extra—like slashing \$300 to \$400 off the price, a few more emulations, extra resident fonts, and increasing the printer's base memory to at least 1MB—to be a truly great deal.

## Fujitsu RX7100

by Bruce Brown

This year's Fujitsu fleet of black-and-white laser printers includes four models, all of which use the company's own LED dry electrophotography page printer engines. The Fujitsu RX7100 is the most junior of Fujitsu's page printers and, at \$2,150, the least expensive. It's not quite cutting-edge material, but it's adequate for modest needs.

At first glance the RX7100 looks a bit odd; it might even be mistaken for a dot matrix printer because of the top of the

### Fujitsu RX7100

## Fonts & Features

HP LaserJet Plus											
Helvetica			Times			Courier			Line printer		
Bold	Italic	Sub-Super Underline	Bold	Italic	Sub-Super Underline	Bold	Italic	Sub-Super Underline	Bold	Italic	Sub-Super Underline
8.9-point											
10-point											
12-point											
14-point											
Scalable											

Font and emulation cards, priced between \$145 and \$195, are available for the Fujitsu RX7100.

unit there are two paper insertion slots that look like printer platens. These slots are used with top-mounted paper bins: one bin is standard; the second, a \$405 option. Each bin can accommodate 150 sheets of paper and has a width adjustable up to 8.5 inches. Acceptable paper weights range

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## HOW TO GET THE MOST OUT OF YOUR LASER PRINTER

by Edward Mendelson

That laser printer on your desk produced amazingly fine text and graphics when you first took the printer out of the box. After a few months of use, its output still looks fine, but you're no longer amazed by it, even though you've plugged in an ultracartridge, loaded down your hard disk with soft fonts, and added enough RAM to the printer to give you full-page graphics at 300 dots per inch.

No matter what you've done to it, that printer still hasn't reached its limits. Enhancement boards that plug into your computer can double the quality of your laser's text and vastly increase the quality of its graphics. And while these boards add new features and capabilities to your printer, they take nothing away from the functions it already has. You'll pay anywhere from \$695 to \$3,395 or more, but the board you buy will preserve your initial investment while producing better output than before. All of these enhancements work with the HP LaserJet Series II; some will work with virtually any other printer built around a Canon laser engine.

### ADDING IN POSTSCRIPT

Although the current generation of PostScript enhancement boards doesn't increase the resolution of 300-dpi laser printers, the group does add flexibility. (For full reviews of PostScript add-in boards, see "Add-In Boards for the HP LaserJet: Post-Purchase PostScript," April 11, 1989, p. 205.) Unfortunately, scalable PostScript fonts printed at 300 dpi look more jagged than the corresponding bitmapped soft fonts normally used with a LaserJet, so you don't gain any print quality when you add the versatility of PostScript. Still, a PostScript board does let you use a LaserJet to proof output that will later be printed by a typesetter.

Only one PostScript board, QMS's \$2,495 JetScript, uses true Adobe PostScript fonts and opens up Adobe's enormous library of soft fonts. The JetScript is the slowest PostScript board, but its output is by far the best of the

breed, and it can be installed in a network server. If speed matters more than print quality, the PostScript board to choose is Princeton Publishing Labs' PS-388 Accelerator, which earned an Editor's Choice in our April issue. This \$2,795 add-in doesn't print text much more quickly than the JetScript board, but it prints PostScript graphics as much as 30 times as fast.

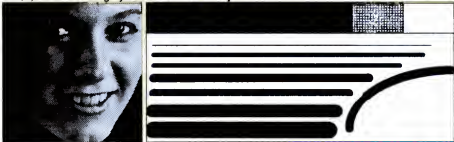
### POSTSCRIPT ON-DISK

You don't have to buy an add-in board to print PostScript pages on a non-PostScript page printer. Five PostScript-emulation software packages can do the trick: Custom Applications' \$495 *Freedom of Press*, LaserGo's \$195 *GoScript* (with 13 fonts) and \$395 *Go-*

*Script Plus* (35 fonts), and QMS's \$195 *UltraScript PC* (25 fonts) and \$497 *UltraScript PC Plus* (47 fonts). With all five, you print your PostScript files to disk, and then use the software to print the files to the printer. With *UltraScript PC*, which requires an 80286- or 80386-based PC, you can print directly from an application to the printer if you have 1.5MB of extended memory to spare. All of these packages produce excellent output, with *Freedom of Press* a tad better.

Emulation cartridges, which plug into the font cartridge slot, offer the newest way to add PostScript to your laser printer. Pacific Data Products recently introduced PacificPage, a \$695 cartridge that lends Phoenix Technol-

\$1,295 256-shade gray-scale LaserJet II-compatible add-in board



\$695 64-shade gray-scale LaserJet II-compatible add-in board



\$3,995 600- by 300-dpi LaserJet II-compatible add-in board





ogies' PostScript emulator, *Phoenix-Page*, to LaserJet II and compatibles. Hewlett-Packard has also announced a \$995 Adobe PostScript cartridge for the new HP LaserJet Series IID and plans to bring out one for the new HP LaserJet Series IIP.

#### SPECTACULAR 600 BY 300

By far the best thing you can do to a page printer is attach it to a LaserMaster LX6 Professional controller. This \$3,995 board (\$500 more for Micro Channel machines) comes with 4MB of RAM and outputs 600- by 300-dpi resolution on a printer normally limited to 300 by 300. The doubled resolution makes a dramatic difference in text quality and brings laser printers very close to the level of low-end typesetters.

The LX6 prints text at about the same speed as the LaserJet itself and prints graphics up to ten times as fast. The board comes with drivers for *Page-Maker* and other *Windows* applications, *Ventura* and other *GEM* applications, and *Microsoft Word 5.0*. In addition, WordPerfect Corp. supplies drivers for *WordPerfect*, and drivers from Z-Soft Corp. and other vendors are due soon. A Presentation Manager driver will ship in time for OS/2 1.0.

The LaserMaster board is supplied with 35 scalable Bitstream fonts that correspond to the fonts supplied with most PostScript printers. Any Bitstream typeface can be added. The *Windows* and *Ventura* drivers allow you to scale type up to 1,200 points, and to use or create complex special type effects such as fill and background patterns and sloping type. The LX6 is the only desktop printer that printed the *Ventura* "compatibility page" test correctly—not even the best PostScript printers could accomplish that feat.

The LX6 is one of the few printer enhancement boards that can be used in a network, though the network version costs an extra \$995. You can expand it to 6MB of RAM for even faster printing; alternatively, you can buy a stripped-down 2MB version that prints at 300 by 300 dpi but can be upgraded later for 600 by 300 dpi output.

#### PHOTOGRAPHIC LASERJET

As you'll see from the samples of scanned photos in the *PC Magazine* guide to laser printers, printing a photograph with some 300-dpi page printers gives you a rectangle full of miscellaneous dots that resembles a malicious parody of a newspaper halftone. Two add-in boards to use only with the LaserJet Series II will make photographs look like photographs, although the boards won't work their magic on text. Both boards also accelerate image printing to speeds many times greater than those possible with an unadorned LaserJet.

For the most spectacular improvement, install DP-Tek's \$1,295 LaserPort GrayScale board. This board prints up to 256 shades of gray in a level of detail that equals or approaches photographic printing. But because of the mechanical limitations of the HP LaserJet, the results look different from any other form of photographic printing and have a slightly unfamiliar and artificial feel. However, you cannot get grayscale printing even remotely approaching this quality with any other desktop publishing hardware, and thus the LaserPort GrayScale has no competition.

The next step down from the DP-Tek board is Intel's \$695 Visual Edge (\$895 for a Micro Channel version), which uses technology licensed from DP-Tek. This board makes lasers print newspaper-quality halftones in up to 64 shades of gray or up to 100 lines per inch. Both boards come with drivers for *Windows*, *Ventura*, and other *GEM* applications, and they are also supported by Z-Soft's graphics programs. The slight inconvenience of these products is that unfortunately they cannot be used with software print spoolers; however, they speed up graphics printing so dramatically that you may not care about giving up the spooler.

The ideal page printer enhancement board would be one that could give you the text output of the LaserMaster LX6 as well as the graphics output of the DP-Tek LaserPort GrayScale. However, by the time that as-yet-uninvented board comes into existence, you'll probably have long since retired your

300-dpi page printer. Until that time, one of these boards can give your existing laser printer powers of enhanced resolution and scalable fonts it never knew it had. ■

#### ADD-IN BOARDS

##### DP-Tek LaserPort GrayScale

DP-Tek Inc., 245 North Hydraulic, Wichita, KS 67214; (316) 269-3068.

**List Price:** \$1,295 **Requires:** 1MB or more of expanded memory, Hewlett-Packard LaserJet Series II.

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##### Intel Visual Edge

Intel PCEO, 5200 NE Elam Young Pkwy., Hillsboro, OR 97124; (800) 538-3373, (503) 629-7354.

**List Price:** \$695; MCA version, \$895 **Requires:** 1MB or more of expanded memory, Hewlett-Packard LaserJet Series II.

CIRCLE 549 ON READER SERVICE CARD

##### LaserMaster LX6

Professional LaserMaster Corp., 7156 Shady Oak Rd., Eden Prairie, MN 55344; (612) 944-6069.

**List Price:** \$3,395 with 4MB RAM, \$4,495 with 6MB RAM; network versions, \$995 extra; 2MB RAM version (300 by 300 dpi only), \$2,195; equivalent versions for MCA bus, \$500 extra. **Requires:** Printers supported include HP LaserJet, LaserJet Plus, LaserJet Series II or IID; Canon LBP-CX, LBP-8II, LBP-8IIIF, LBP8-III; Brother HL-8e; other printers using the Canon SX engine.

CIRCLE 550 ON READER SERVICE CARD

##### Princeton Publishing PS-388

##### Accelerator

Princeton Publishing Labs Inc., 19 Wall St., Princeton, NJ 08540; (609) 924-1153.

**List Price:** \$2,795 **Requires:** HP LaserJet Series II (no RAM needed in host computer). Installable in network servers.

CIRCLE 601 ON READER SERVICE CARD

##### QMS JetScript

QMS Inc., 1 Magnum Pass, Mobile, AL 36618; (205) 633-4300.

**List Price:** \$2,495 **Requires:** 2MB RAM, HP LaserJet Series II. Installable in network servers.

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Includes 5 applications: spreadsheet (Lotus® 1-2-3® file-compatible), word processing (ASCII file-compatible), telephone/address book with tone dialing, appointment diary with multiple alarms, and calculator

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Super-twist LCD screen

256x64 pixel graphics mode; 40x8 text mode (with a moveable window on 80x25 character display)

60-pin expansion bus

# Actual Price. \$399<sup>95</sup>

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A whole system of peripherals expands this palm-sized marvel to a complete "mini office" for business people on the go.

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- RAM Memory Cards
  - 32K..... \$ 79.95
  - 64K..... \$129.95
  - 128K..... \$199.95
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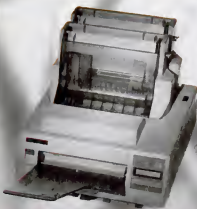
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# PRINTERS LASER PRINTERS

## FUJITSU RX7100



## PC MAGAZINE FACT FILE

Fujitsu America Inc., 3055 Orchard Dr., San Jose, CA 95134; (800) 626-4686, (408) 432-1300.

List Price: \$2,150; Diablo 630 emulation cartridge, \$99; Epson FX-85, IBM Proprietary XL emulation cartridges, \$129 each; HPGL emulation cartridge, \$149.

Dimensions (HWD): 6.7 x 16 x 24.25 in. Weight: 37.5 lbs.

Emulations: Hewlett-Packard LaserJet Plus In Short: The Fujitsu RX7100 is a 5-ppm printer that is Hewlett-Packard LaserJet Plus compatible and has a top-mounted cut-sheet or envelope feeder. The RX7100 is pleasant to use, but it's not price competitive in the low-end page printer market because of its older-generation HP compatibility and lackluster graphics performance.

CIRCLE 402 ON READER SERVICE CARD

from 17 to 28 pounds. The paper-feed bin setup works well, boasting smooth operation and hardly any noise. Even better, the printer doesn't forget an unprinted page's contents when a bin runs out of paper.

As a straight HP LaserJet Plus compatible, the fonts and features are limited to Courier and Line Printer. There are three font- and emulation-card slots on the bottom front of the machine for options. You can add IBM Graphics Printer and Epson FX-85 compatibility with a single \$129 card; IBM Proprietary and Diablo 630 compatibility cards are \$99 each, and the HPGL plotter emulation costs \$149.

These relatively inexpensive compatibility cards work with the other Fujitsu page printers as well, making them an even better bargain. Fujitsu also sells 30 different font-set cards, most priced at \$145, with a few costing \$195.

For the most part, the 300-dot-per-inch

RX7100's print quality met our expectations, though the graphics print sample was a bit gray, even when I cranked the print density control all the way up, and the image was a wee bit off in some places. The RX7100 managed to exceed its speed rating of 5 pages per minute by scoring 5.2 ppm on our text speed test.

The RX7100's control panel consists of a single-line 16-character LCD screen with membrane-style buttons and LED indicators. Menu function and menu-based feature selection are straightforward and reasonably simple to use. In addition, parallel and 25-pin serial ports are both standard.

Fujitsu's 7100 series printers use a single-piece toner and photoconductor cartridge. The \$185 unit, called a process car-

## The appealing extras of the Fujitsu RX7100PS include true Adobe PostScript and an HP LaserJet II emulation.

tridge, is simple to install, and at a rated life of 6,000 sheets, it has one and a half times the life expectancy of an HP cartridge. The RX7100's design duty cycle is 3,000 pages per month with a 5-year life expectancy, for a total of 180,000 pages.

The RX7100's standard memory is 640K, exceeding the original LaserJet Plus's 512K. You can add memory at \$495 for 1MB, \$995 for 2MB, and \$1,995 for 4MB for a large print buffer or for complicated graphics applications.

At \$2,150, the Fujitsu RX7100 isn't priced very aggressively when you consider that other companies' printers often include more resolutions and fonts for similar prices. In addition, you can buy the same printer from Blue Chip for a couple of hundred dollars less. Further limiting the RX7100 is the HP LaserJet Plus emulation, which is now old. This model gets passing grades, but Fujitsu's other page printers with extra features or faster speeds are more cost-competitive, even though they're more expensive.

## Fujitsu RX7100PS

by Bruce Brown

When it comes to Fujitsu's RX7100 models, more is better: the \$4,495 Fujitsu RX7100PS page printer is a better deal than its lookalike brandmate, the \$2,150 RX7100.

The appealing extras of the RX7100PS include true Adobe PostScript (Version 50.3), as well as the more current HP LaserJet Series II compatibility. The RX7100PS also comes standard with two cut-sheet paper bins and 2MB memory standard (though not expandable), and it can still take the same emulation and font card options available for the RX7100.

The RX7100PS uses an MC68000 12.5-MHz processor to run PostScript and has 1.5MB of ROM for the PostScript code. The RX7100 also comes with PostScript's 13 font families, making 35 fonts in all.

The RX7100PS is still just a 5-page-per-minute printer. On the PC Labs text speed tests, it achieved 5.4 ppm in HP mode and 5.09 ppm in PostScript mode. The graphics speed test results were about 45 seconds in LaserJet mode and 112 seconds in Apple LaserWriter II emulation. (For Macintosh owners, the RX7100PS

## Fujitsu RX7100PS Fonts & Features

	PostScript											
	Helvetica	Times	Courier	Line printer	Helvetica	Times	Courier	Line printer	Helvetica	Times	Courier	Line printer
Bold												
Italic												
Sub-Super												
Underline												
8/9-point												
10-point												
12-point												
14-point												
Scalable												

	HP LaserJet II											
	Helvetica	Times	Courier	Line printer	Helvetica	Times	Courier	Line printer	Helvetica	Times	Courier	Line printer
Bold												
Italic												
Sub-Super												
Underline												
8/9-point												
10-point												
12-point												
14-point												
Scalable												

The Fujitsu RX7100PS, which comes with the standard 35 PostScript fonts, also accepts the RX7100 cards.

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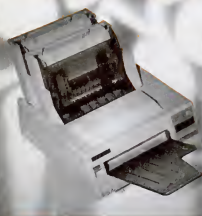
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## PRINTERS LASER PRINTERS

### FUJITSU RX7100PS



#### PC FACT FILE

Fujitsu America Inc., 3055 Orchard Dr., San Jose, CA 95134; (800) 626-4686, (408) 432-1300.  
**List Price:** \$4,495; Diablo 630, Epson FX-85, HPGL, IBM Proprinter XL, emulation cartridges, prices unavailable.  
**Dimensions (HWD):** 6.7 x 16 x 24.25 in.  
**Weight:** 37.5 lbs.  
**Emulations:** Apple LaserWriter II, Hewlett-Packard LaserJet Series II, PostScript  
**In Short:** With both HP LaserJet Series II and real Adobe PostScript standard compatibilities resident, the Fujitsu RX7100PS is a good deal that deserves close scrutiny. 2MB of RAM are standard, and the LED engine pushes the page printer to its full 5-page-per-minute rating.

CIRCLE 399 ON READER SERVICE CARD

The 12-page-per-minute RX7200 came in at 11.4 ppm on PC Labs text speed tests. It offers both parallel and serial interfaces and includes HP LaserJet Plus, Epson FX-85, IBM Proprinter XL, and Diablo 630 emulations. The five resident typefaces are available in both portrait and landscape orientations.

The RX7200 is rated at 10,000 pages per month with a 5-year life or an expected output of 600,000 pages. If you print mostly dense graphics, these expectancies will decrease. The 300-dot-per-inch RX7200's print quality is very good, with graphics images much darker than those produced in our RX7100 graphics test output.

The RX7200 doesn't share the simple one-piece toner and photoconductor cartridge of the Fujitsu 7100 printers. There are five different consumable parts in the RX7200: toner cartridges good for 2,500 pages each, which cost \$68 for a case of four; a \$190 developer good for 20,000 pages; a \$250 drum also good for 20,000 pages; a \$15 60,000-page transfer unit; and a \$139 120,000-page filter. The machine is user-serviceable, and none of the parts or supply replacements are difficult to change. Each procedure is also clearly

#### Fujitsu RX7200

### Fonts & Features

#### HP LaserJet Plus

	Helvetica	Times	Courier	Line printer
	Bold	Italic	Sub-Super	Underline
8/9-point				
10-point				
12-point				
14-point				
Scalable				

#### IBM Proprinter XL

	Bold	Italic	Sub-Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

The Fujitsu RX7200 adds Roman, Prestige Elite, and Times Roman to the standard LaserJet fonts.

### FUJITSU RX7200



#### PC FACT FILE

Fujitsu America Inc., 3055 Orchard Dr., San Jose, CA 95134; (800) 626-4686, (408) 432-1300.  
**List Price:** \$3,995, HPGL emulation cartridge, \$149.  
**Dimensions (HWD):** 17.5 x 17.5 x 22.75 in.  
**Weight:** 77 lbs.  
**Emulations:** Diablo 630, Epson FX-85, Hewlett-Packard LaserJet Plus, IBM Proprinter XL  
**In Short:** The Fujitsu RX7200 is rated at 12 ppm and equipped with the four most common PC printer emulations. This workhorse printer is suitable for office applications using a variety of software and can print up to 10,000 pages per month. The price is right for this impressive machine.

CIRCLE 408 ON READER SERVICE CARD

adds an AppleTalk serial interface to the RX7100 interface roster.)

If all you need is basic HP laser compatibility, you sure don't have to spend close to \$5,000; Fujitsu's RX7100 or another low-cost HP clone will do. But if you need a PostScript printer and your budget is restricted, take a hard look at the RX7100PS. The combination of features for the price is extremely appealing.

## Fujitsu RX7200

by Bruce Brown

The Fujitsu RX7200 is a prime example of how far laser printers have come in the 5 years since the introduction of the original HP LaserJet. At \$3,995, the RX7200 is about the size and cost of the LaserJet, but performs one and a half times as fast and offers a lot more standard features. This printer is designed for heavy office use and clearly rises to the occasion.

illustrated in the user manual.

In a design similar to that of the current HP LaserJet Series II, the paper exit tray allows for sheets to come out faceup in reverse order or face-down in collated order on the top of the printer in a recessed holding area. A single standard paper cassette holds 250 sheets of either legal- or letter-size paper. If you want to blow some money, you can buy an extra paper cassette for the exorbitant sum of \$599. Another slight downside is that envelopes must be fed manually.

Base memory is 640K, with options priced the same as those for the RX7100. The RX7200 also takes the same selection of font cartridges as the RX7100. The built-in typefaces include Line Printer, Roman, Courier, Prestige Elite, and Times Roman, all in both portrait and landscape orientations.

Most of us don't need the RX7200's speed and can get page printer performance and quality for as little as half the RX7200's price. You could equip a Fu-

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## PRINTERS LASER PRINTERS

jitsu RX7100 with the three missing emulations for \$228 and buy a couple of font cartridges to save at least a thousand dollars. Then you'd even be able to print envelopes through the RX7100's single-bin sheet feeder. But you wouldn't have the high speed and the heavy duty cycle of the RX7200.

The RX7200 is clearly intended for multiple-application software in office environments that make heavy demands. The four emulations included with the printer cover most PC software, except for high-end graphics and desktop publishing packages. And the 10,000-page-per-month rating makes this printer suitable for running roughly 500 sheets a day every business day for 5 years. If you need that volume, the RX7200's price is very hard to beat.

## Fujitsu RX7300E

by Bruce Brown

So you're dying for the fastest laser printer you can get with a high duty cycle—and at a reasonable price to boot? Think Fujitsu RX7300E. The \$9,350 printer is the high

**You're dying for one  
of the fastest lasers with  
a high duty cycle?**

**Think Fujitsu RX7300E.**

end of Fujitsu's 7000 series page printers with LED engines. Rated at up to 18 pages per minute, this unit cranked out almost 15 ppm on the PC Labs text speed test.

Leave lots of room for this baby. It measures 12 by 19.5 by 20 inches (HWD) in its minimally operative configuration. Add a 1,000-page hopper-style sheet feeder, and the 7300E grows about a foot in height. And at 95 pounds, don't count on moving it around a lot.

The 7300E's emulations read like a shopping list. The standard compatibilities include 9-pin IBM Proprinter, Epson FX-80, Hewlett-Packard LaserJet Plus, Diablo 630, Qume Sprint 11, and Fujitsu M304X Line Printer. Pay \$149 for the HPGL plotter compatibility integrated circuit (IC) card option, and then just try to find PC software you can't print! The only major printer command set that the 7300E doesn't include is PostScript, and a high duty cycle printer such as this one probably wouldn't be used for graphics or desktop publishing applications anyway.

Six typefaces are resident: Courier 12-point, Prestige 10-point, Times Roman 8-point, Times Roman 12-point, Helvetica 14-point, and Line Printer 8-point. A control on the front of the printer lets you orient the print in any of four directions. While PostScript compatibility isn't included, DDL—a less popular page-description language—does come with the 7300E.

Interfaces include standard Centronics parallel and 25-pin serial ports. The non-upgradable memory totals 2.5MB. You'll recognize the control panel from the ones found on the other Fujitsu page printers.

The user manual states that printer installation and consumable parts replacement is for trained personnel only. But without training, I followed the relatively clear instructions and illustrations in the manual and put it all together myself. If you've never done this kind of thing before, however, you should probably get

### Fujitsu RX7300E

## Fonts & Features

### HP LaserJet Plus

	Helvetica	Times	Courier	Line printer
8-9-point	Bold Italic Sub-Super Underline	Bold Italic Sub-Super Underline	Bold Italic Sub-Super Underline	Bold Italic Sub-Super Underline
10-point				
12-point				
14-point				
Scalable				

### IBM Proprinter XL

	Bold	Italic	Sub-Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

The Fujitsu RX7300E adds Helvetica Bold, Times Roman, and Prestige Elite to the standard LaserJet fonts.



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someone more experienced to help you, especially since some of the consumable parts are fragile or potentially messy.

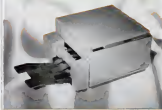
A two-unit toner kit costs \$82, with each unit rated for 12,000 pages. Other consumables include a \$320 drum, a \$42 transfer unit, and a \$65 developer unit—all rated for 65,000 pages—and a \$15 ozone filter good for 120,000 pages.

The length of part-replacement intervals gives a hint as to this printer's design. Not only is it fast, but it is also expected to run a lot. The monthly duty cycle rating is 50,000 pages, with a total life expectancy of 5 years, or 3 million pages.

The standard paper cassette handles letter, legal, A4, and B4 sheets. An extra cassette costs a reasonable \$110. For big jobs, you'll want the \$1,296 1,000-sheet hopper so that you don't have to keep refilling the 250-sheet cassette.

Those who would even consider such a monster workhorse as the RX7300E know who you are. Find a Fujitsu dealer and see a demo of the RX7300E: it's good, fast, and built to last.

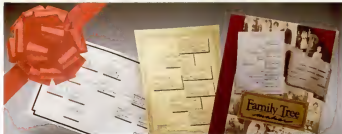
FUJITSU RX7300E



PC FACT FILE

Fujitsu America Inc., 3055 Orchard Dr., San Jose, CA 95134, (800) 626-6686, (408) 432-1300.  
List Price: \$9,350; HPGL emulation cartridge, \$149.  
Dimensions (HWD): 12 x 19.5 x 20 in.  
Weight: 95 lbs.  
Emulations: Diablo 630, Epson FX-80, Fujitsu M304X Line Printer Hex Dump, Hewlett-Packard LaserJet Plus, IBM Proprinter, Layout DDL, Qume Sprint 11.  
In Short: The Fujitsu RX7300E pumps out text at close to 15 pages per minute. High-volume offices can use this one, which is too expensive and a tad too complicated to service smaller sites. Multiple emulations mean it'll be hard to find software that won't run with this printer, it has everything but PostScript.

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### PRINTERS

### LASER PRINTERS

## Hewlett-Packard LaserJet Series IID

by Alfred Poor

With every printer company from here to Bora Bora making Hewlett-Packard LaserJet compatibles, the question is obvious: Why buy a printer that works "just like a LaserJet" when you can get the real thing? This year's real thing, the HP LaserJet Series IID, costs \$4,295 and continues in the tradition of HP printer standards.

The LaserJet IID is nearly identical to its smaller stablemate, the oft-mentioned and oft-imitated LaserJet Series II printer. The most significant difference shows up in the IID's paper handling: the IID sports two 200-sheet paper cassettes, compared

The IID is different from the Series II in other ways, too. It comes with more standard fonts, including 12-point Courier, Times Roman, and Helvetica Bold for headlines. It can rotate any portrait font for landscape printing. The documentation is an improvement over the Series II manuals, with expanded information about using the printer with popular programs. It still could use some more explanation of the PCL command set, but it's quite good all the same. The IID comes with 640K of RAM—slightly more than the Series II but still not enough for lots of downloaded fonts or full-page graphics at 300 dots per inch.

One advantage the IID has over its older sibling is a PostScript option, which was announced but not available at press time. According to HP, the \$995 font cartridge gives the IID true Adobe PostScript. For those of you who want HP-quality, guaranteed LaserJet compatibility and also want PostScript, this may be the way to go. But the total list price of \$5,290 makes this package less than a bargain. You can find less expensive and more flexible printers that offer PostScript and LaserJet emulations, albeit without the HP name and reputation.

The remaining benefits of the IID are the same as with the smaller Series II. You get the ease of maintenance that comes with the Canon print engine; the toner and drum come in one self-contained unit. Toner coverage for black areas is excellent; if anything, it tends to be too black.

You get the same paper-handling choices in all modes—faceup or facedown, from the paper trays or manual feed. And the manual-feed faceup combination gives you a nearly arrow-straight paper path that is well suited to heavy stocks and transparencies.

The IID has the same front-panel controls as a Series II, and while it is not totally intuitive, the English text responses in the LCD message window make it fairly easy to configure and operate.

And best of all, it's a LaserJet. No need to worry about compatibility, since this is the one that so many others emulate and that so many applications support. It's no slouch on speed, either. Rated at 8 pages per minute, it clocked 7.5 ppm—the same speed as the original II reviewed in the 1987 printer issue—on the PC Labs text speed test. Even in duplex mode it managed 6.3 ppm for the 20-page test. Its times for the graphics speed test were just under 36 seconds.

### Hewlett-Packard LaserJet Series IID Fonts & Features

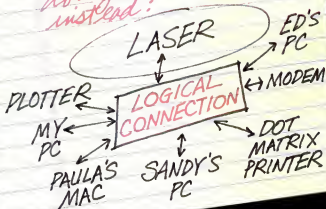
	HP LaserJet IID				HP LaserJet II			
	Helvetica	Times	Courier	Line printer	Helvetica	Times	Courier	Line printer
Bold	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Italic	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Underline	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sub-Super	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
8.9-point	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
10-point	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
12-point	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
14-point	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Scalable	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

The HP LaserJet Series IID comes with more standard fonts than the LaserJet II; it rotates portrait fonts for landscape printing.

with the Series II's one, and there's an optional envelope tray for \$340. The extra cassette adds three important benefits. To begin with, it can hold two types of paper—letterhead and second pages, for example—at the same time. The second benefit is most useful for shared situations or heavy-volume printing: the feed can shift automatically to the bottom tray when the top one is empty, cutting down on waiting time for reloading.

But the best benefit is a bit of magic: the IID can print on both sides of a single page. You see, D stands for duplex. The extra depth in the case that accommodates the second paper tray also makes it possible to snake the printed page around for a second pass. For many situations, this feature can cut paper consumption nearly in half, easing your paper budget.

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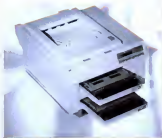
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SERIES IID

FACT FILE

EDITOR'S CHOICE

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List Price: \$4,295; PostScript cartridge, \$995.  
Dimensions (HWD): 12.75 x 18 x 32.5 in.  
Weight: 74 lbs.  
Emulations: HP LaserJet Series II (with  
extensions)

In Short: The HP LaserJet IID builds on its  
heritage as a close relative of the LaserJet Series  
II, adding a few more fonts, a bit more memory,  
and a lot of new paper-handling options. Its dual-  
cassette design puts more paper on-line, and its  
duplex printing can cut down on paper costs.

CIRCLE 415 ON READER SERVICE CARD

The LaserJet IID is a bit expensive compared to the Series II, especially if you don't expect to be using the dual-bin or duplex printing features. But if you're sharing a printer and need as much as a full ream of paper on-line at one time, or if you want to print on both sides at once, then one thing is for certain: there's nothing better than the original.

Hewlett-Packard  
LaserJet Series IIP

by Alfred Poor

There are a few laser printers that cost less than HP's new \$1,495 LaserJet Series IIP, and there are a few laser printers out there that take a little less space on your desk. But, with an expected street price around \$1,000, there's no better value on the market for a low-end laser printer than the HP Series IIP.

That's big talk about a little printer, but the IIP can back it up. The small size is a direct result of using the new Canon laser

## PRINTER LANGUAGES: The Next Generation

by M. David Stone

Not so long ago, the only issue for a printer was that it produce readable text and recognizable graphics. Then came the Hewlett-Packard LaserJet family and clones. As we started seeing proportionally spaced fonts like Times Roman instead of typewriter-style, monospaced text, expectations went up.

Then came the Apple LaserWriter, followed by other Adobe PostScript printers and, more recently, clones. Once again, expectations are beginning to rise. The typical PostScript printer offers 35 built-in typefaces and lets you print any size text for each typeface. It also lets you print each typeface in portrait, landscape, or indeed any other orientation. The disadvantage is price: a budget PostScript clone sells for about \$4,500.

At least that's how things stand now. But as of this writing, the fundamental approach to printer control is in transition, and several important changes are about to take place.

## BITMAPMED VS. SCALABLE FONTS

There is one essential difference between the way most printers handle text and the way a PostScript printer handles text. Most printers use bitmapped fonts, in which each character is individually designed, literally bit by bit. The designer can arrange the bits—or dots—for any given character, fooling the eye into seeing a carefully smoothed curve, for example. But if you try enlarging or shrinking a bitmapped character, the edges become ragged. In other words, if you change the size, you have to redesign the character. That's why you have to buy a different font for each font size.

PostScript printers use outline fonts, with characters stored as mathematical

formulas. The formulas can generate outlines for each character at any arbitrary size. Additional algorithms fill in the outlines and smooth curves. Outline fonts are also known as scalable fonts because they can be scaled to any size.

The obvious advantage to scalable fonts is flexibility. For each bitmapped font in your printer, you have one typeface in one size. For each scalable font, you have one typeface in an infinite number of sizes. Not surprisingly, the move is on to offer scalable fonts in non-PostScript printers as well.

## SCALABLE LASERJET FONTS

The change has already begun. In this year's batch of printers, the Brother HL-8PS offers 35 scalable fonts in its HP LaserJet Series II mode as well as in its PostScript-compatible mode. Similarly, the Canon LBP-8 Mark III offers 9 built-in scalable fonts, plus a \$295 font card with 22 more. Canon has also announced a plug-in Adobe PostScript option.

And this is only the beginning. By the time this article is published, Hewlett-Packard will have disclosed its plans for PCL Level 5 at a software developer's conference in mid-October. (PCL is the Hewlett-Packard printer language. The LaserJet Series II family uses PCL Level 4.) HP's official stance is that there will not be a PCL Level 5 product in 1989. Hence, it's a good bet that HP will introduce its much-rumored PCL Level 5 printer in the first half of 1990.

As of this writing, HP has already announced its intention to use the new Intellifont font-scaling technology in future printers. HP says it's also looking at a faster way of doing graphics. This matches the industry rumors that Level 5 will include both scalable fonts

print engine: the P110. This compact 22-pound unit is rated at 4 pages per minute, half the speed of the larger Canon SX engine-based printers. But this design offers many familiar features: excellent 300-dots-per-inch print quality, dark and smooth areas of black in graphics, and an easy-to-maintain cartridge that combines toner,

drum, and other consumable components.

There are some differences from the larger LaserJets, however. The toner/drum cartridges are rated for 3,500 pages, compared with 4,000 for the larger models. The duty cycle is lower: a maximum of 6,000 pages per month compared with 16,000 for the LaserJet IID—but that's in



and some integration of PCL with HPGL—HP's plotter language.

It's also worth noting that HP has announced a PostScript cartridge for the LaserJet Series IID, as well as one for the new IIP. As with the Canon PostScript option and Pacific Data Product's new PacificPage, this will plug into a font cartridge slot. The cartridge for the IID should be available at about the time this article is published.

#### THE PROMISE OF GPI

In addition to PostScript and PCL, a new printer control language called GPI is now on the horizon. GPI is derived from the Graphics Programming Interface (GPI) of OS/2's Presentation Manager. Functionally, GPI is much like PostScript. In fact, the two graphics systems share the ability to create fonts and other images on-screen as well as at a printer. The most important practical difference is that PostScript is a current reality, fully implemented in any number of printers, typesetters, film recorders, and even display devices. GPI so far is primarily a promise.

At this writing, there are no GPI printers, although QMS has announced two: a color thermal printer, the SmartWriter PM-10, and a black-and-white printer based on the Canon SX engine, the SmartWriter PM-810. QMS expects the PM-810 to sell for about \$5,000, and the PM-10 to sell for about twice that.

If you believe in the value of WYSIWYG, then you have to appreciate the logic of GPI: use GPI to draw text and graphics both on-screen and at the printer, and what you see on-screen should exactly match what you get. The same logic applies to using Display PostScript on-screen along with a PostScript printer. But, of course, Presentation Manager isn't using Display PostScript on-screen. It's using GPI.

keeping with the slower print speed.

The speed is not as slow as you might think, however. In our text speed test, the Series IIP came close to its rated speed with a 3.9-ppm result, which translates into roughly 264 characters per second (see "How We Tested the Printers"). And in the graphics test, it clocked in at about

#### INCOMPATIBLE STANDARDS

The current reality of PostScript means that you can design a publication on a desktop system and hand it over to a professional printer for final printing. As a case in point, consider *PC Magazine*. About 25 percent of this issue is produced through PostScript. And according to Gerard Kunkel, PC's director of design and electronic publishing, the figure should be 100 percent by the spring of 1990. As a real-world user of PostScript, Kunkel would prefer to see Microsoft and IBM support PostScript as a standard rather than challenge it.

Jonathan Seybold, whose organization sponsors the Seybold Computer Publishing Conference, agrees. "From a user's standpoint, a single standard would be a good idea," he says. "The bad news is that we are not getting one. The good news is that at least we are down to a small number." Seybold points out that multiple font technologies will have problems exchanging data. For example, if two systems have differences in character width for similar fonts, the line breaks won't match. Thus if you format your file for a GPI printer then send it to a colleague who uses PostScript, the formats—as shown and printed on your two systems—won't match.

#### POSTSCRIPT DUMPING?

Adding one more wrinkle to an already complicated picture, Apple has recently sold its 16 percent share of Adobe stock, leading to a widespread impression that Apple is abandoning PostScript—a view that Apple rejects. Greg Decoteau, product manager for Apple's LaserWriter II, says that Apple will continue to offer Adobe PostScript on the LaserWriter line, but that "we intend to develop an alternative interpreter—by which we mean an alternative to Adobe PostScript."

53 seconds, which puts it ahead of many printers with faster-rated engines.

The IIP has a number of improvements over the older LaserJet II. It has more internal fonts; you get Courier in normal, bold, and italic in both 10- and 12-point, plus Line Printer. And like the IID, the IIP can rotate any portrait font for landscape

printing; internal, cartridge, or downloaded font. It accepts one font cartridge in a side slot and comes with 512K memory for graphics and downloaded fonts. Two memory slots take either 1MB or 2MB upgrade cards, offering a maximum configuration of 4.5MB.

For now, however, he says that "Apple will continue to sell a PostScript LaserWriter printer. And particularly an Adobe PostScript printer at the moment."

Jim Gable, Apple's product line manager for printing and imaging, points out that Apple has always had a mix of QuickDraw and PostScript printers. "We have always used PostScript and will continue to do so," he says; "Apple maintains its commitment to the PostScript world." Meanwhile, Pat Marriott, director of marketing for systems division at Adobe, points out that Apple has a relatively recent contract with Adobe—less than 6 months old at this writing—to develop a new PostScript device.

So, what does this all mean when it comes to choosing a printer? "Users are not, on the whole, happy with proprietary environments," says Jonathan Seybold. "The edge is going to PCL and PostScript." Seybold feels that PCL will have the largest base, with PostScript remaining the high-end choice largely because of its substantial lead over GPI in typesetting-level output devices. PostScript will also be the preferred choice for those who need to exchange files among different environments.

James Upham, director of electronic printer industry service at DataQuest, has a similar view. Upham sees PCL providing scalable fonts and other specifics that the typical office worker needs, while PostScript "is obviously also here to stay." Upham finds GPI's positioning to be a puzzle. "The printer industry isn't necessarily ready for GPI," he says. "It could take 2 years." In the meantime, Upham's advice to users is simple: "Buy the cheapest possible PCL printer, get PostScript in a font cartridge, and wait for upgrades."

The documentation for the printer is

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## PRINTERS LASER PRINTERS

### Hewlett-Packard LaserJet Series IIP Fonts & Features

HP LaserJet IIP		Helvetica	Times	Courier	Line printer
8-9-point	Bold	Yes	Yes	Yes	Yes
	Italic	Yes	Yes	Yes	Yes
	Subscript	Yes	Yes	Yes	Yes
	Underline	Yes	Yes	Yes	Yes
10-point	Bold	Yes	Yes	Yes	Yes
	Italic	Yes	Yes	Yes	Yes
	Subscript	Yes	Yes	Yes	Yes
	Underline	Yes	Yes	Yes	Yes
12-point	Bold	Yes	Yes	Yes	Yes
	Italic	Yes	Yes	Yes	Yes
	Subscript	Yes	Yes	Yes	Yes
	Underline	Yes	Yes	Yes	Yes
14-point	Bold	Yes	Yes	Yes	Yes
	Italic	Yes	Yes	Yes	Yes
	Subscript	Yes	Yes	Yes	Yes
	Underline	Yes	Yes	Yes	Yes
Scalable	Bold	Yes	Yes	Yes	Yes
	Italic	Yes	Yes	Yes	Yes
	Subscript	Yes	Yes	Yes	Yes
	Underline	Yes	Yes	Yes	Yes

The new HP LaserJet Series IIP has more internal fonts than the LaserJet II; it can rotate portrait fonts for landscape printing.

about the best HP has produced to date for any of the LaserJets. There is a small booklet that helps you set up the machine; an HP representative said they designed the system to be set up by a novice in less than half an hour, and I expect that they are on target because it took me less than 5 minutes. The fat user manual covers all manner of useful details, from paper specifications to how to select fonts using the PCL printer language. This manual also includes two tear-out cue cards: one for the PCL instructions and one that maps out the front-panel configuration menu.

The front panel is easier to use than the ones on the other LaserJets. It has large, raised buttons with attractive printed legends, and the two-line, eight-character LCD window is angled for easy reading. You can even get the messages to appear in your choice of languages: English, French, German, Italian, or Spanish. Imagine having your laser printer *parle avec vous*—how Continental!

The IIP's weakest link is its paper handling. You feed paper via a multipurpose bin that can accept a range of paper sizes and envelopes, but it is a stack feed and can hold no more than 50 sheets at a time. There are both faceup and facedown output paths, but there is no straight-through paper path for heavier stock; the specifications cite a maximum paper weight of 28 pounds.

HP has addressed paper handling with an optional bottom paper tray that has a list price of \$195 (including a tray for letter-size paper). This tray holds up to 250 sheets of paper, yet it raised the printer's height only from about 8 to 10 inches.

Many people may find that they want to purchase this option right from the start. With the extra tray installed, you can use the same commands that the IID uses to select the two paper sources, which means that many word processors and other programs already know how to use this feature.

The original LaserJet struck the first note in the death knell for the daisy wheel printer 6 years ago. With its low list price (and anticipated lower street price), the IIP stands a good chance of doing the same for the high-end 24-pin impact dot matrix printers—except for applications with heavy paper-handling requirements, such as multipart forms. It prints faster, better, and much more quietly for about the same price, while offering more flexibility than a 24-pin dot matrix.

In the \$1,000 to \$1,500 list price range, there is no better value than this powerhouse. The LaserJet Series IIP should become the standard in its class.

### HEWLETT-PACKARD LASERJET SERIES IIP



### PC FACT FILE EDITOR'S CHOICE

Hewlett-Packard Co., 19310 Pruneridge Ave.,  
Cupertino, CA 95014; (800) 752-0900  
List Price: \$1,495

Dimensions (HWD): 8.25 x 13.75 x 27.5 in.  
Weight: 22 lbs.

Emulations: LaserJet Series II, IID (with extensions)

In Short: Based on a new 4-ppm Canon laser engine, the HP LaserJet IIP is slower than the original LaserJet II but has more fonts, as well as the ability to rotate any portrait font—internal, cartridge, or downloaded soft font—on the fly. Other pluses include an easy-to-use front panel and excellent documentation. Its weakest link is paper handling. With its low price, it redefines the low-end laser market and could take a bite out of the high-end 24-pin dot matrix sales. The LaserJet IIP offers a remarkable value.

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## IBM LaserPrinter

by M. David Stone

IBM's printers generally fall into one of two categories: boring or dazzling. Some are completely uninspired, such as the IBM Graphics printer, otherwise known as the Epson MX, while others truly challenge the competition. The \$2,695 IBM LaserPrinter is definitely one of the latter, offering users a combination of speed, paper handling, and price that outclasses the competition.

Its chief competitor, of course, is the Hewlett-Packard LaserJet Series II, and IBM has taken careful aim. Not satisfied to match the LaserJet, IBM has chosen the

so that just a 1.5-inch handle protrudes.

A \$399 optional module fits under the printer, adding a second paper tray with a hefty 500-sheet capacity. Both trays adjust to accommodate several paper sizes, including A4, B5, and letter size. Either one can be replaced with an optional legal-size tray as well, though the legal-size tray will project 3 additional inches from the front of the printer.

Another point in the LaserPrinter's favor is its speed. Where the Canon engine offers a rated 8 pages per minute and a measured 7.5 ppm in the HP Series II printers, the IBM engine is rated at 10 ppm. On PC Labs test speed tests, the LaserPrinter scored between 8.9 and 9 ppm, depending on the emulation. This 20-percent speed difference is enough to be noticeable.

The LaserPrinter's 36-second score on the graphics speed test in LaserJet mode is a match for the HP LaserJet Series IID reviewed in this issue. In other emulations, the printer managed 20- to 23-second times for graphics.

The Canon engine is known for its crisp, dark text and graphics, and on this score the IBM engine is its equal. The text output has none of the copier quality of lesser engines. Solid areas in graphics are truly solid, and the shades-of-gray patterns on the PC Labs graphics tests retain their detail. Similarly, the scanned photo retains all the shading and detail appropriate to the particular emulation.

The LaserPrinter offers a total of three emulations. The so-called IBM ASCII mode worked well on the PC Labs emulation tests for the IBM Graphics printer, the Epson MX-80, and the 9-pin IBM Proprinter. Curiously, IBM has made no attempt to offer a 24-pin Proprinter mode. Instead, the other two emulations are for HPGL plotter language and the HP LaserJet Series II.

IBM has wisely accepted the supremacy of the LaserJet standard in the marketplace and has chosen not to buck the trend. On PC Labs tests, the LaserPrinter performed without a problem. In the IBM ASCII mode, the LaserPrinter worked with Epson MX, IBM Graphics, and 9-pin IBM Proprinter emulations.

Like the Canon engine, the IBM engine sports a manual feed tray—except that it resides at the back of the printer instead of the front. Far more interesting is the optional \$329 envelope feeder, which re-

places the manual feed tray while letting you feed individual sheets manually. The envelope feed is interesting because it works; if you've ever tried feeding envelopes through almost any other printer—laser or not—you know that envelopes have a tendency to jam. IBM has dealt with that problem as well as anyone I've ever seen. To prove the point, I ran about 150 envelopes through the printer without problems; these included some envelope stock that my own Canon-based printer often mangles.

In fact, the paper feed in general is remarkably sure. The "S" path for the paper feed would seem to invite problems; however, none materialized in the PC Labs tests. As with most laser printers, the IBM provides you with a facedown output bin for collated output and an alternate C-shaped path faceup bin. In addition, you can use the manual feed tray with the faceup bin for a straight-through path, an op-

### IBM LaserPrinter Fonts & Features

HP LaserJet II				
Helvetica	Times	Courier	Line printer	
Bold	Bold	Bold	Bold	Bold
Sub-Super	Sub-Super	Sub-Super	Sub-Super	Sub-Super
Underline	Underline	Underline	Underline	Underline
8.9-point				
10-point				
12-point				
14-point				
Scaleable				

IBM ASCII				
Bold	Italic	Sub-Super	Underline	
10 cpi				
12 cpi				
Compressed				
Proportional				

The new IBM LaserPrinter offers built-in fonts equivalent to the LaserJet II's. Font cards and soft fonts are also available.

route of one-upmanship. The company has built its own engine from the ground up, taking care to match or beat the LaserJet's Canon engine on every score.

The first thing you'll notice about this printer is its small size. Compared to the LaserJet II and other printers based on the Canon engine, the LaserPrinter's 14.25- by 14.25-inch footprint is more like a toeprint, as project leader Bill O'Brien puts it. The basic printer stands about 12.75 inches high and includes a 200-sheet paper tray. The tray slides into the bottom front of the printer, much like a dresser drawer,



IBM Corp. (contact your local authorized IBM dealer); (800) IBM-2468 ext. 130.

List Price: \$2,695

Dimensions (HWD): 12.75 x 14.25 x 28 in.

Weight: 33 lbs.

Emulations: Epson MX, HPGL, HP LaserJet Series II, IBM Graphics printer, 9-pin IBM Proprinter.

In Short: The IBM LaserPrinter is certainly a challenge to the HP LaserJet. About 20 percent faster and 40 percent smaller than the LaserJet, this IBM-designed and -manufactured laser printer features quality output. It also offers superb paper handling: it's the first laser printer that can handle envelopes without jamming. Of course, it's only a LaserJet clone, but it's a clone from a highly reliable source.

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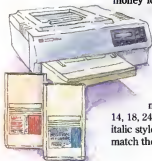
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PRINTERS  
LASER PRINTERS

tion that is helpful for heavy stock.

One drawback to the LaserPrinter is its front-panel controls. Instead of using an LCD menu with English choices, as has become standard, the LaserPrinter takes a step backward by requiring arcane commands. To print a list of fonts, for example, you hold the Orientation button down and press the Font button. To change the default font, you first go off-line, then hold the Code button down while repeatedly pressing the Font button to move through the font choices—ingeniously identified as 1, 2, 3, and so on. One compensating factor is that buttons for other functions, such as choosing the envelope feed, are clearly labeled. And if you're used to the ProPrinter front panel, the LaserPrinter's will seem familiar.

The LaserPrinter offers essentially the same built-in fonts as the LaserJet II: Courier, Courier Bold, and Courier 16.7 for Line Printer. Additional fonts are available on font cards—not cartridges—for \$142 to \$245. IBM also sells downloadable fonts for \$199 per package. And there's even more to look forward to from Big Blue: IBM has promised a \$1,099 13-font and \$1,999 35-font Adobe PostScript option

for the second quarter of 1990.

To choose between an HP LaserJet Series II and the IBM LaserPrinter, you may as well toss a coin. The LaserPrinter is 20 percent faster, 40 percent smaller, and has vastly improved paper handling—in particular, envelope handling. But it doesn't offer any additional memory or fonts in its base configuration; it doesn't offer a significantly better price; it's not hardware-compatible with the HP font cartridges you may already have; and it is, after all, an HP clone. Although it may not be the LaserJet killer it could have been, it's still awfully good.

## Mannesmann Tally 905

by M. David Stone

The Mannesmann Tally 905 offers LaserJet-quality output and LaserJet Series II emulation without the LaserJet price. Selling for \$1,995, this printer is one of the few lasers to break the \$2,000 mark. Inter-

Mannesmann Tally 905

## Fonts & Features

	HP LaserJet II							
	Helvetica		Times		Courier		Line printer	
	Bold	Italic	Subscript	Underline	Bold	Italic	Subscript	Underline
8.9-point								
10-point								
12-point								
14-point								
Scalable								

In addition to the LaserJet II fonts, the 905 font cartridges are \$360 each.

estingly, some of the other inexpensive lasers reviewed in this issue—such as the Desktop Systems' Laser Beam and the Spear Technology Desktop Laser Printer—are virtually identical. All three are inexpensive; unfortunately, the Spear and the MT905 are both flawed in their HP emulations.

Aside from its price, one of the stron-



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# PRINTERS LASER PRINTERS

gest features of the MT905 is its print quality. Built around the TEC 1305 engine, the unit produces text that is just a touch less crisp than the HP LaserJet II's. That makes the MT905 second-best, but still far better than much of the competition.

Graphics quality is also excellent—not quite up to the original, but excellent for the cost. On the PC Labs graphics speed test, the shades-of-gray patterns filled in as solid black to an even greater degree than that of the LaserJet II. The scanned photograph was acceptable but lost some detail in comparison with the LaserJet. Although the difference in graphics is more apparent than the difference in text quality, it's still small enough not to be a problem for most needs.

Alas, the MT905 failed absolutely—and repeatedly—on the HP compatibility test, crashing to the point of needing to be turned off and on before it would work again. The cause proved to be an inability to handle macros. When we removed the macro commands from the file, the test page printed but still had difficulty with the downloaded font test.

The relatively low price tag comes with a relatively low speed. The TEC 1305 engine is rated at 6 pages per minute, trans-

lating to a measured speed of 5.1 ppm on the PC Labs text speed test. On the graphics speed test, the MT905 clocks in at a lackadaisical 65 seconds. To put this figure in perspective, remember that, on the PC Labs test, 5.1 ppm translates to about 146 characters per second. That's still a good clip when you consider that NLQ mode on a dot matrix printer will rarely be above 100 cps, and that you generally get a speed that high only from printers costing over \$2,000.

The MT905 has room for one paper tray, and the tray is noteworthy for its flexible paper handling. The tray cover includes an adjustable manual feed similar to the one on the LaserJet II. Inside the tray, you'll find an internal width adjustment that accepts widths between 3.25 and 8.5 inches and works much the same way. Paper length can be shortened to about 6 inches. A still-nicer touch is that the tray is open on the back, allowing you to use legal-size paper with a hidden extension. So the combination of adjustments means that you can use the single tray for legal-, letter-, A4-, and memo-size paper. You can even use it for envelopes.

The paper path choices are similar to those in the LaserJet II. A bin in the top of the printer lets the paper fall facedown in collated order. An alternate exit creates a straight-through path for transparencies, label stock, and heavyweight paper. Mannesmann Tally sells an optional \$35 output tray for the rear exit.

Setting up this printer is more difficult than it ought to be because of a poorly designed instruction manual with hopelessly complicated line drawings. But once you have the toner, developing unit, and charger installed, using the printer is easy enough. Because LaserJet II emulation is the only option, all you have to do is connect your computer, install software for the LaserJet II, and start printing.

As you would expect in a budget emulation, there is no attempt to improve on HP's three resident fonts. Mannesmann Tally offers font cartridges for \$360 each, with a single cartridge containing the equivalent of either two or three standard HP cartridges, according to the company.

The MT905 is a pleasant but somewhat flawed little printer. Although it's notable for impressively good output and convenience of paper handling, its difficulty with macros and downloaded fonts is worrisome. In truth, I like the MT905 despite

its flaws, but I'd like it a lot more without them. If you're looking for a low-cost LaserJet II clone for light to medium duty and you don't need anything fancy, the MT905 may be worth looking at, but don't be surprised if you trip over one of its built-in gremlins.

## Mannesmann Tally 910 UPS

by M. David Stone

The Mannesmann Tally 910 UPS (Universal Publishing System) is one of the few printers in the known universe that uses a PC as a peripheral. And this \$5,495 printer isn't satisfied with just any computer. While it can limp along with a plain-vanilla 8-MHz 286, Mannesmann Tally firmly recommends a 386 system or a fast 286. And regardless of the computer, the printer requires a hard disk—preferably a high-speed hard disk.

The MT910 UPS is best thought of as a printer system rather than just a printer. The printer itself consists of a 10-page-per-minute Kyocera engine with two 250-page paper trays, a facedown output bin, and an alternate straight-through path with a face-

### Mannesmann Tally 910 UPS Fonts & Features

PostScript emulator				
Helvetica	Times	Courier	Line printer	
Bold	Bold	Bold	Bold	Bold
Italic	Italic	Italic	Italic	Italic
Sub-Super	Sub-Super	Sub-Super	Sub-Super	Sub-Super
Underline	Underline	Underline	Underline	Underline
8-9-point				
10-point				
12-point				
14-point				
Scalable				
HP LaserJet				
Helvetica	Times	Courier	Line printer	
Bold	Bold	Bold	Bold	Bold
Italic	Italic	Italic	Italic	Italic
Sub-Super	Sub-Super	Sub-Super	Sub-Super	Sub-Super
Underline	Underline	Underline	Underline	Underline
8-9-point				
10-point				
12-point				
14-point				
Scalable				

The Mannesmann Tally 910 UPS comes with 35 images UltraScript fonts, some of which can be used in LaserJet mode.

### MANNESSMANN TALLY 905



### PC MAGAZINE FACT FILE

Mannesmann Tally Corp., 8301 S. 160th St., Kent, WA 98032; (800) 843-1347, (206) 251-5524.  
List Price: \$1,995; Diablo 630, Epson FX-80, or IBM Proprinter, emulation cartridge, \$210 each.  
Dimensions (HWD): 8 x 24.25 x 14.75 in.  
Weight: 35 lbs.  
Emulations: HP LaserJet Series II  
In Short: The MT905 is a straightforward LaserJet II clone in a less-expensive and slower version. Output from the TEC 1305 engine manages a close second to LaserJet II quality. Unfortunately, in the tested version of the printer, the LaserJet II emulation had some flaws.

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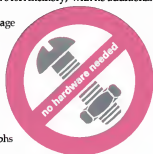
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PRINTERS  
LASER PRINTERS

up bin. All of the printer's hardware smarts are on a board that goes inside your computer. And all of the fonts and the control software—4.5MB worth—go on your computer's disk. The board connects to the engine through a video interface to achieve the fastest possible data transfer.

One of the advantages of keeping the fonts and software on-disk is that you can add fonts, upgrade software, or even add new emulations simply by copying the ap-

signing a printer this way. First, the printer software uses up RAM: 25K for the PostScript mode and either 94K or 121K for HP mode, depending on whether you use the pop-up control screen. Also, a slow disk and slow processor can become a bottleneck for print speed, which accounts for Mannesmann Tally's recommendation of a fast computer and fast hard disk.

To prove the point, we ran the UPS through two sets of speed tests—one done on an 8-MHz IBM PC AT and the other on a 25-MHz Compaq 386. Not surprisingly, the speeds were generally faster on the Compaq. In HP mode, the graphics speed test took about 157 seconds on the AT, compared to about 49 seconds on the Compaq. In PostScript mode, the difference was even more dramatic: 570 seconds on the AT compared to about 110 seconds on the Compaq. That's more than three times as fast for HP mode on the Compaq and more than five times as fast for PostScript mode.

The difference in text speed was also significant for HP emulation, with 5.3 ppm on the AT compared with 8.9 ppm on the Compaq. Interestingly, there was little difference between the two performances in PostScript mode, with a speed of about 8.2 ppm on both computers.

There is a potential problem in PostScript mode. On the PC Labs benchmark program, the printer scored an appallingly low 0.4 ppm. The 8.2 ppm rating resulted from printing the text file with *Microsoft Word*. A Mannesmann Tally representative says the company has never seen this problem before. Still, the possibility remains that you may run into it with some other program. If you're interested in the printer, check to see if the company has tested it with your favorite software.

Print quality is high. Text and graphics are suitably dark, crisp, and clean. The scanned photo retained the levels of detail and shading you would expect for each of the modes. On the emulation tests, the UPS generally behaved as advertised. Note that the HP emulation is strictly LaserJet—not LaserJet Plus or Series II. That means you don't get downloaded fonts, graphics primitives, or macros. On the PC Labs test, the printer also failed to go to landscape mode in HP emulation.

A nice extra is that you can use the PostScript fonts in the HP mode by specifying an HP cartridge choice in the control software. Unfortunately, you can only install

one ghost cartridge at a time, though you can change it at will if you have the pop-up software loaded.

Happily, the manuals for the MT910 are emphatically not typical of Mannesmann Tally's usual fare. Rather, they are well written, well designed, and well illustrated.

An interesting network option is the \$495 *PS-Publish*, a modified version of *PS-Print* from Brightwork Development. The *PS-Publish* version has been customized to work specifically with the MT910 UPS on Novell networks. According to Mannesmann Tally, it will let you attach the UPS to any station on a Novell network (running *NetWare 2.1* or later) and use the printer from any other station.

The MT910 UPS is an interesting printer with a narrow focus. The name—Universal Publishing System—is exactly right. This is a DDL and PostScript printer with a minimal HP LaserJet utility added. Its natural home is either a network—preferably a dedicated or lightly used station—or a standalone system with heavy-duty desktop publishing needs. If you don't like printers that need a computer slot and disk space, you won't like the MT910 UPS. But this is certainly one of the better implementations of that arrangement.

## NCR 6435

by Tami Peterson

The NCR 6435 laser printer operates as flawlessly as the HP LaserJet Series II it emulates, and at \$2,395, it's similarly priced. So why would you want to buy it instead of the real thing? That answer may depend on how attractive its inexpensive optional emulations are. If you're looking for that kind of incentive, the NCR 6435 is a good deal.

The NCR 6435 comes with Diablo 630 emulation and offers Epson FX-86e/IBM Proprinter XL and HPGL as \$280 plug-in cartridges. The best value is the Epson/IBM card, which gives you two emulations for the price of one, thereby endowing you with a total of four simultaneous emulations.

Once accessible, emulation can be initialized via the front control panel. The 16-line LCD confirms the transfer to available printer modes. But emulation can also be initiated through software commands, making the NCR 6435 a natural choice for a network environment where multiple us-

### MANNESSMANN TALLY 910 UPS



#### PC FACT FILE



Mannesmann Tally Corp., 6301 S. 180th St., Kent, WA 98032; (800) 843-1247; (206) 251-5524

List Price: \$5,495

Dimensions (HWD): 14.25 x 35.25 x 17.75 in.

Weight: 72 lbs.

Emulations: Imagen DDL Language, HP LaserJet, PostScript interpreter

In Short: The Mannesmann Tally 910 UPS, specifically designed for heavy-duty desktop publishing needs, has a combination of DDL, PostScript compatibility, and an HP LaserJet-level emulation for utility printing. Its unusual design puts the printer's board in your computer and its fonts on your hard disk, letting you upgrade the printer's features easily but taking a toll on the computer's RAM and disk space.

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propriate files to your hard disk. As a practical demonstration, Mannesmann Tally sells two versions of the printer. The Document Description Language version offers DDL only, which resides along with 22 typefaces on-disk. The UPS version gives you PostScript compatibility (through Imagen UltraScript), HP LaserJet emulation, and 17 additional typefaces.

The DDL-only version of the MT910 comes on eight disks; the UPS version adds six more. If you start out with the DDL version, priced at \$4,895, you can upgrade to the UPS version for \$600. You won't pay a penalty for upgrading at a later date.

There are a few disadvantages to de-

PRINTERS  
LASER PRINTERS

ers might access the same printer desiring different emulations.

NCR has simplified the potential complications of selecting emulation through software by creating what it terms an All Emulation Command Set. Within any of its supported modes, the 6435 accepts the same ASCII, decimal, or hexadecimal commands to modify the current emulation. This lets you create one batch command per emulation for all users—one that will reset the printer without regard to present settings. Other All Emulation commands include similar generic instructions for changing print orientation and designating the number of copies.

The NCR 6435 employs a TEC 1305-B engine—not the fastest in the world. The unit required close to 1 minute to print the graphics test. Likewise, the text pages were output at an average of 5.6 per minute. But it's easy to discount these speed infractions in view of the printer's other strengths; on the PC Labs torture tests, the 6435 demonstrated top-flight HP emulation. Unlike the other TEC-based printers reviewed in this roundup—such as the Mannesmann Tally 905 and the Spear Desktop Laser Printer, both of which

NCR 6435

Fonts & Features

	HP LaserJet II				
	Helvetica	Times	Courier	Line printer	
Bold					
Italic					
Sub-Super					
Underline					
8.9-point					
10-point					
12-point					
14-point					
Scalable					

The NCR 6435 accepts HP-compatible font cartridges.

crashed on PCL macros—the NCR 6435 wore the true colors of HP on every test where the slightest hint of inexact HP emulation would be detected.

Though it may act like an HP LaserJet II, the NCR 6435 occupies less desktop space. It has a height of just 8 inches and weighs only 36 pounds. Its one paper tray,

which holds a maximum of 150 sheets, accommodates letter-, legal-, and international-size paper. An adjustable single-sheet feeder rests on top of the tray for manual loading of envelopes and card-stock paper. Manual feed is invoked through the control panel and redirects output from the default C path to an uncollected pass through the printer. This straight paper path means that envelopes won't curl and that the printer can accept paper as heavy as 34 pounds. An envelope tray is available from a third-party source and will hold up to 50 envelopes.

Because of its compact size, the NCR's toner cartridge and separate optical photoconductor system are also small. The cartridge holds enough toner to print 1,500 pages during normal usage. This may be the reason NCR packages two cartridges together in one replacement pack. The pack sells for a total of \$22.50, and your first toner cartridge is included free with the printer. The photoconductor, which costs \$138, should be replaced approximately every 10,000 pages.

To ensure that your printer is in top working condition, NCR offers its customers an on-site parts-and-labor maintenance

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NCR 6435



PC FACT FILE

NCR Corp., 3718 N. Rock Rd., Wichita, KS 67226; (316) 636-6570.  
List Price: \$2,395; HPGL emulation cartridge, \$280; IBM Proprinter XL/Epson FX-86e emulation cartridge, \$280.  
Dimensions (HWD): 8 x 25 x 17 in.  
Weight: 35 lbs.  
Emulations: Diablo 630, HP LaserJet Series II  
In Short: You'll find no snags in working with this HP LaserJet II-compatible printer. It even accepts HP font cartridges. The design is compact, and operation is effortless. The standard HP LaserJet Series II and Diablo 630 emulations, as well as optional Epson FX-86e/IBM Proprinter XL, and HPGL modes, are software selectable, which may make this printer a good choice for network use.

CIRCLE 417 ON READER SERVICE CARD

contract for \$350 a year. With yearly maintenance, NCR insists that the printer can be used indefinitely.

In line with its exceptional HP compatibility, the NCR 6435 accepts all HP font cartridges and will conveniently house up to two at a time, just like the LaserJet II. However, NCR plans to release its own HP-compatible font cartridges, including a 25-in-1 supercartridge. The NCR 6435 cartridges, excluding the supercartridge, will retail for \$245 each. Whether you'll want to buy NCR's cartridge over HP's will probably depend on which has the lower street price; the cartridges appear to be identical.

If the standard 512K memory in this printer is not enough, upgrades are available. The maximum upgrade is to 4.5MB and costs an additional \$2,199. Upgrades of 1MB and 2MB cost \$549 and \$1,099, respectively. All memory enhancements are user installable.

By year's end, a further enhancement for the 6435 will be available in the form of a PostScript emulation board. The new PostScript card will piggyback the printer's motherboard, allowing you to continue to use an emulation cartridge that you

already own. Once the board is available, it will be possible to emulate a total of five printers simultaneously.

If the NCR 6435's ensuing PostScript emulation is of the same quality as its present HP LaserJet II product, this printer may be headed for success. But you won't have to look to the future to find reasons for buying this printer today. If you require excellent HP LaserJet II emulation and find value in adding other emulations currently available, the return on your investment will be realized now.

## NEC Silentwriter LC 890XL

by Tami Peterson

Realizing that most offices require more than one printer standard, NEC built the \$6,995 Silentwriter LC 890XL with three. The Silentwriter offers the font prowess of PostScript, the nearly universal compatibility of HP PCL, and even includes something to satisfy the laser-phobe as well as work with any dated software: a Diablo 630 emulation.

The 890XL comes with two paper cartridges—one legal-size and one letter-size—with a capacity of 250 sheets each. The cartridges can be used simultaneously; for instance, you might put letterhead in one cartridge and second sheets in the other. Or, for high-volume printing, you can choose to combine the two cartridges. When one cartridge runs out of paper, the printer will then automatically pull paper from the second. This option is selected through the front control panel.

Thirty-five resident Adobe typefaces are accessible in PostScript emulation. Three of them—Courier, Times, and Helvetica—are available when in HP LaserJet emulation. With a total of four port selections (Centronics parallel, RS-232, RS-422, and AppleTalk), it is reasonable that NEC asks you to purchase a cable separately.

The various print emulations are accessed through the control panel. A 2-line 16-character LCD allows enough space for the printer to communicate its current actions, any problems that have occurred, and what you can do to help it recover. There is even a handy "flush job" command that you can quickly invoke to alleviate misprints without powering down. An-

other nice control lets you prevent the printer from processing the annoying start-up page on power-up.

The primary emulation of the 890XL is PostScript. PC Labs tests revealed this to be perhaps the greatest strength of this printer. Graphic output was sharper and more distinct in PostScript than in HP emulation, and font control was also more germane to PostScript. Fonts selected in HP emulation are derived from the PostScript set, and our font tests detected some slight irregularities.

Curiously, the first line in the test paragraph was consistently dropped. Also, the

### NEC Silentwriter LC 890XL Fonts & Features

	PostScript											
	Helvetica	Times	Courier	Line printer	Helvetica	Times	Courier	Line printer	Helvetica	Times	Courier	Line printer
	Bold	Bold	Bold	Bold	Bold	Bold	Bold	Bold	Bold	Bold	Bold	Bold
	Underline	Underline	Underline	Underline	Underline	Underline	Underline	Underline	Underline	Underline	Underline	Underline
8.9-point												
10-point												
12-point												
14-point												
Scalable												
	HP LaserJet II											
	Helvetica	Times	Courier	Line printer	Helvetica	Times	Courier	Line printer	Helvetica	Times	Courier	Line printer
	Bold	Bold	Bold	Bold	Bold	Bold	Bold	Bold	Bold	Bold	Bold	Bold
	Underline	Underline	Underline	Underline	Underline	Underline	Underline	Underline	Underline	Underline	Underline	Underline
8.9-point												
10-point												
12-point												
14-point												
Scalable												

The NEC Silentwriter LC890XL offers the standard 35 Adobe PostScript fonts, some of which are available in LaserJet mode.

boldface Times Roman font would appear in Helvetica bold. These facts were discussed with a NEC representative, who indicated that no problems had ever been reported by customers using HP emulation with popular applications like word processors, desktop publishers, and spreadsheets. Use with certain tax applications has produced errors, however, and NEC is currently working on the problem.

Preparing the 890XL for initial operation is straightforward. The accompanying documentation is consumer-oriented, anticipating possible quandaries by offering clear, comprehensive instructions. To one accustomed to the toner cartridges of



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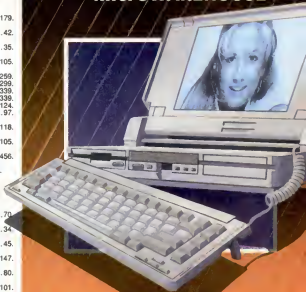
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Ventura Publisher 2.0 .....	489.
Z-Soft	
PC Paintbrush IV+ .....	119.

## LANGUAGES

Borland International	
Turbo Assembler Debugger 1.0 .....	95.
Turbo C Prof. Pack .....	159.
Turbo Pascal 5.5 .....	96.
Turbo Pascal Prof. Pack .....	185.
Microsoft	
C Compiler 5.1 .....	279.
Quick Basic 4.5 .....	64.
Quick C 2.0 .....	63.

## PARADOX



**Paradox 3.0 (Borland Int'l)**  
Paradox 3.0 enables you to build custom applications quickly with the Paradox Application Language. Complete with sophisticated graph and chart features that allow you to turn tables into charts with one keystroke. Paradox 3.0 combines ease of use with powerful relational capabilities in a database perfect for multiple users. **\$435.**

## ENTERTAINMENT & EDUCATION

Activision	
Ghostbusters II .....	26.
Broderbund	
Where in Time is Carmen S.D. ....	28.*
Epye	
The Games: Winter Edition .....	52.
Microprose	
F-19 Stealth Fighter .....	38.
Microsoft	
Fight Simulator .....	33.
Teacherware (with audio) .....	New
Teacher in a Box: Lotus 3.0 .....	New
PC Startup Kit .....	New

## MEDIA

BASF Dieke (box of 10)	
5 1/4" DS-HD (1.2Mb) .....	19.
Maxell Dieke (box of 10)	
3 1/2" DS-HD (1.44Mb) .....	34.
Polaroid Dieke (box of 10)	
Formatted & DataRescue .....	Call
Sony (box of 10)	
3 1/2" DS-HD (1.44Mb) .....	38.

## ACCESSORIES

American Covers	
Mouse Mats .....	7.
Curtis	
Ruby Plus w/Fax & Modem .....	59.
Interfax	
Cables & Gender Chargers .....	Call
Kensington	
Masterpiece Plus .....	95.
Targus	
Leather Carrying Case .....	139.
Nylon Carrying Case .....	54.



**Managing Your Money 5.0 (MCA)**  
Andrew Tobias' Managing Your Money 5.0 puts a financial wizard to work for you. This unique program helps you stay on top of your expenditures, income tax records, investments, plans for the future and net worth. **\$118.**

## INPUT DEVICES

Kensington	
Expert Mouse PS/2 .....	115.
Logitech	
Logitech Scanman .....	179.
Series 9 Mouse (bus) .....	75.
Series 9 w/PS/2 (bus-ser) .....	92.
Microsoft	
Mouse w/Paintbrush (bus-ser) .....	105.
Mouse w/Windows & Paint (bus-ser) .....	131.
MicroSpeed	
FastTRAP (bus-ser) .....	104./94.
PC Trac (bus-ser) .....	85./75.
The Complete PC	
Half-Page Scanner 400dpi .....	183.

## Canon Laser Beam Printer LBP-8III (Canon)

Satisfy all your printing needs with Canon's new Mark III laser printer. Versatility enables you to print scientific, professional looking text and graphics without add-ons. The Canon LBP-8III features include extensive memory, a sophisticated vector graphics command set, scalable text and the speed of eight pages per minute. **\$1643.**

## PRINTERS & CARTRIDGES

Canon	
LBP-8III Laser .....	1645.
Citizen	
120D and 180D .....	138./159.
GSX-140 .....	New
NEC	
520X-5300 .....	489./668.
Pacific Data Products	
1-2-4 Memory Bg. w/2mg. ....	499.
25 Cartridges in One! .....	269.
Pacific Page .....	550.
Plotter in a Cartridge .....	255.
Panasonic	
KX-P1124 Dot Matrix .....	329.
KX-P 1180 .....	190.
KX-P 1191 .....	228.
Toshiba	
Express Writer 301 portable .....	341.

## DRIVES

Imega	
540mb 1144Mb Int .....	992.
44Mb Storage Cartridge .....	79.
Procom Technology	
3 1/2" 1.44Mb Ext(AT) .....	249.
5 1/4" 360K Ext floppy PS/2 .....	210.
Tesla	
3 1/2" 1.44Mb AT Floppy Drive .....	95.
5 1/4" 1.2Mb Floppy Drive .....	89.
Solutions for PC/XT	
3 1/2" 1.44Mb Floppy & Ctr .....	157.
3 1/2" 720K Floppy & Ctr .....	137.

- Visa and Mastercard accepted.
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- Corporate purchase orders subject to credit approval.
- All products are covered by 120 day limited warranty.\*
- CT residents add 8% sales tax. NJ residents add 6% sales tax.

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- Shipping charge \$7 per order up to 7 lbs. \$1 per lb. above 7 lbs.
- UPS ground service also available upon request - \$3 per order. UPS orders placed by 6:00 p.m. (5 weekdays), ship same day.
- Actual freight charges apply for computers, hard disks, terminals, tape back ups, monitors and printers.
- Alaska, Hawaii, outside continental U.S., APO/FPO call for information.

\*Defective software replaced immediately. Hardware replaced or repaired at our discretion. Item availability and price subject to change without notice.

Software is not copy protected, except where marked by asterisk.

**CONTENT RULES:** 1. Entries must be received on or before 1/31/90. 2. Winner selected in random drawing by attorneys for Micro Warehouse Inc. (MWH), whose decisions are final. 3. Prize subject to availability. MWH reserves the right to substitute whatever cash value up to \$5,000. 4. Winner responsible for taxes. 5. Odds of winning depend on number of entries. 6. MWH will announce the winner on or around 2/28/90. Winner will be notified by mail. Dates subject to change at the discretion of MWH. If unable to contact any winner, an alternate will be selected by random drawing. 7. Contest is open to US residents except where prohibited by law. Employees of MWH and suppliers not eligible. 8. Prize - one Compaq 386 SLT 286 w/40MB RAM and 40MB Hard Drive.

## MODEMS & FAX BOARDS

Computer Peripherals	
Vive Modem 24 .....	New
GVC Chenet	
Mini Modem 2400bd AC/DC .....	157.
Practical Peripherals	
Modem 2400SA Ext. ....	174.
Quadram	
JT Fax Board 4800bd Int .....	215.
The Complete PC	
The Complete Fax 4800bd .....	249.
U.S. Robotics	
Sportster 2400 Ext. ....	185.

## MONITORS

NEC	
Monitor Multisync 2A .....	495.
Monitor Multisync 3D .....	859.
Monitor Multisync 3G .....	219.
Panasonic	
Pensync C1391 .....	579.
Princeton Graphics	
Ultra-14 VGA .....	539.
Zenith	
ZCM 1490 14" Flat Screen .....	599.

## CAD SOFTWARE

American Small Business Co.	
Design CAD 3D 2.1 .....	205.
Generic Software	
Generic CADD Lvl.3 w/Dot Plot .....	155.
Mathsoft	
Math CAD 2.5 .....	285.

**PC Start Up Kit and Teacher in a Box - Lotus 1-2-3 Ref. 3 (Teacherware)**  
Master all the basic computer skills with the PC Start Up Kit. Easy instructions show you how to use DOS commands for everyday operations. Teacher in a Box - Lotus 1-2-3 Ref. 3 is a training program that utilizes three senses - sight, sound and touch to produce optimum memory retention. You excel quickly and master advanced techniques. **New.**



## NEC SILENTWRITER LC 890XL



### PC FACT FILE

NEC Information Systems Inc., 1414 Massachusetts Ave., Boxborough, MA 01719; (508) 264-8000.  
 List Price: \$6,995  
 Dimensions (HWD): 23 x 18.25 x 20.25 in.  
 Weight: 68 lbs.  
 Emulations: Diablo 630, HP LaserJet Series II, PostScript  
**In Short:** The NEC Silentwriter LC 890XL offers good PostScript and HP PCL emulations. The additional Diablo 630 emulation may add to the printer's value for some offices. Dual paper cartridges and the cost-efficient toner replacement system are further benefits. But if you don't need all of your print emulations in one printer, you may find a better bargain elsewhere.

CIRCLE #11 ON READER SERVICE CARD

Canon engine-based lasers, there is one initially disorienting procedure. The 890XL incorporates a refillable OPC (optical photoconductor) that ships empty. Once slipped under the printer's hood, it is filled with a box of toner via a separate top-loading compartment. Amazingly, no mess results from this procedure.

Aside from clean handling, the refillable OPC system is somewhat cost-effective. Each box contains a claimed 3,000 page supply of toner (with an average of 5 percent black coverage per page). A box sells for \$20. What brings that perceived bargain back into perspective is that the OPC, which costs \$110, must also be replaced. The manufacturer states that this should be done every 7,000 pages or every four boxes of toner, whichever comes first.

NEC also suggests a tune-up every 100,000 pages. The first on-site tune-up will cost you \$399. The second tune-up (after 200,000 pages) costs \$499. At 300,000 pages, the printer should be sent to a service center for a \$699 overhaul. The

400,000- and 500,000-page service calls are then charged at the 100,000- and 200,000-page rates, respectively. According to NEC, your 890XL is ready for retirement after 600,000 pages.

The warranty agreement is standard: 90 days on-site service, or 1 year if shipped to a service center. A new maintenance contract is available that includes on-site parts and labor, as well as support for the first five tune-ups. The contract is \$648 per year, or \$54 per month.

The NEC Silentwriter LC 890XL operates smoothly and offers thoughtful features. NEC is attuned to its customers and has carefully developed support programs to maintain the high quality of this product. This one's a good bet.

## Printronix L2324 Report Expediter

by Robert C. Ullrich

You won't find a Printronix L2324 Report Expediter on many desktops. This sturdy built 132-pound behemoth probably wouldn't fit on most desks. Furthermore, its \$15,500 list price clearly relegates it to a shared-device or networked environment. Indeed, the L2324 is specifically designed to address the stringent requirements for shared printing.

With a duty cycle of 80,000 copies per month, an estimated life of 5 million

●

**The sturdy built  
Printronix L2324 is  
designed for a shared  
printing environment.**

●

copies, and a tested speed of nearly 21 pages per minute, the L2324 is faster and more durable than the industry flagship HP LaserJet models. It operates with an LED array imaging system—considered more reliable than laser technology.

The short, straight paper path from the upper paper cassette to the output tray significantly reduces the chance of paper jams

## Printronix L2324 Report Expediter Fonts & Features

	HP LaserJet Plus							
	Helvetica	Times	Courier	Line printer	Helvetica	Times	Courier	Line printer
6/9-point	Bold	Bold	Bold	Bold	Bold	Bold	Bold	Bold
10-point	Italic	Sub-Super	Underline	Underline	Italic	Sub-Super	Underline	Underline
12-point	Bold	Bold	Bold	Bold	Bold	Bold	Bold	Bold
14-point	Italic	Sub-Super	Underline	Underline	Italic	Sub-Super	Underline	Underline
Scalable	Bold	Bold	Bold	Bold	Bold	Bold	Bold	Bold

The Printronix L2324 Report Expediter offers 24 fixed and 48 proportional fonts on disk.

and permits dependable use of heavier paper stock. The upper and lower paper trays have a total capacity of 800 sheets, and the optional power sheet feeder and stacker (not tested) boosts the unit's capacity to 1,750 sheets of input and 1,500 pages of output. Although not essential for a shared printer, the L2324 doesn't allow user commands to be entered via the operator panel, nor does it support printing envelopes.

The most interesting aspect of the L2324 is its internal 3.5-inch 1.44MB floppy disk drive for loading the operating system, fonts, and diagnostics. The fonts on the internal floppy disk drive load more quickly than soft fonts stored on your PC's hard disk and are much cheaper than the expensive font cartridges found on most other page printers. On the negative side, you are limited to 1.44MB of space on a single floppy disk, since changing disks causes the printer to reboot. Still, the two disks provided by Printronix had 24 fixed and 48 proportional fonts, respectively.

The L2324 boasts terrific flexibility for creating custom combinations of fixed and proportional fonts on floppy disks from the most-recent font generators, such as Bitstream's. Alas, you can't do this yourself. Printronix uses a proprietary format for the font disks—you can't even make a copy of it under DOS. Printronix will create a disk free of charge (this is subject to change) with any fonts that you supply, but it would be better if you didn't have to go through the company.

Two disks came with the printer: the fixed font set has Courier, Line Printer, Prestige, Gothic, and OCR (for optical scanners); the proportional font set has Helvetica and Times Roman, along with

## LIGHTS! CAMERA! PRINT IT! LASER PRINTER TECHNOLOGY EXPLAINED

by Alfred Poor

It's now official: it is no longer accurate to refer to this category simply as "laser printers." We need a term to acknowledge the fact that, while they all produce a single page at a time, many of the printers that are reviewed in this section do not have a laser anywhere within their boxes. It's time to recognize the zappers, blinkers, and winkers of page-printing technology.

So we're going to answer these questions: How do page printers work, and how are the technologies different?

The first schematic drawing shows a generic page printer engine; it works almost the same as a desktop copier. In the center is a photosensitive drum, which the drum corona wire covers with an even charge. When the drum is exposed to light, the charge on its surface changes, creating an exposure area in which the image is "painted" on the drum by laser

or other means. The developer unit is filled with captive plastic beads that impart a charge to the toner particles and carry them to the drum, where they are attracted to the spots on the drum surface that are to be printed. Meanwhile, the paper travels past the transfer corona wire, which gives it a charge that will allow it to attract the toner.

As the paper passes the drum, the toner is pulled onto the paper. Excess toner is then wiped from the drum and the drum is "erased" by the drum corona wire to make it ready for the next image. The paper then travels through the two fusing rollers, which use heat and pressure to melt the plastic toner powder into the paper. Finally, the paper transport system carries the page the rest of the way to the output tray.

There are three basic technologies that are currently being used by page printers. Each of the three has its proponents, who argue that their technology results in more-accurate images or a more reliable design.

Most popular of all is the laser, in

large part because of the incredible success of the small Canon laser print engines. As shown in the second drawing, a diode laser generates a beam that is reflected off a spinning, many-sided mirror, causing it to sweep across the width of the drum. By rapidly turning the laser on and off, the individual dots may be placed to create the image.

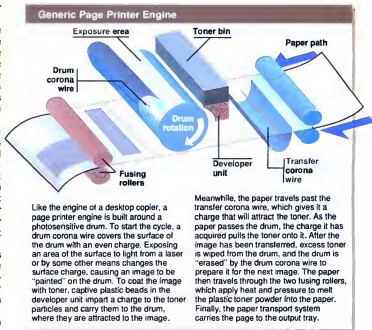
The third drawing shows an LED array: instead of one light source, there are thousands of tiny points. Each pixel

that is present in the 300-dot-per-inch print line has its own tiny light that blinks on and off as the drum turns, exposing a tiny strip of drum to create its part of the image.

The liquid crystal shutter engine in the fourth drawing operates with a process that falls somewhere between the two that were already described. Like a laser, it has a single light source. In this case, it is often a halogen light. As in the LED array engine, every pixel is controlled individu-



### PAGE PRINTER ENGINES



ally. A vast array of liquid crystal shutters wink open and shut in order to let light through and expose the turning drum.

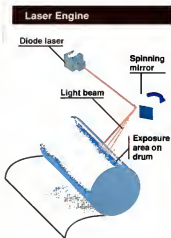
The results of these different approaches are nearly identical. Each design produces 300-dpi output. All three are capable of at least 8-page-per-minute speed ratings. And all three methods have been engineered to fit in remarkably small and lightweight packages.

The different constructions have minor implications in terms of longevity.

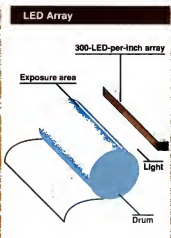
The laser has the fewest components, so presumably there is less chance of something breaking down. On the other hand, the beam must be reflected from one end of the drum to the other, and maintaining accurate control of the beam can be an exceedingly difficult task. The LED and LCS engines do not depend on a moving part like the rotating mirror in the laser engine, so they could be more reliable than the laser. Still, there are thousands of tiny electrical connections that are

involved in each of the systems, and one LED or liquid crystal shutter failure will permanently disable a pixel.

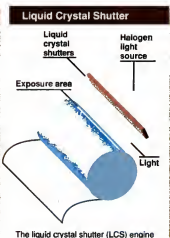
As tested in PC Labs, printers using these three technologies didn't produce output that differentiates them from one another. The variations tended to be more pronounced from engine to engine than from category to category. But even so, nonlaser page printers deserve some respect, even if they don't get a new name.



In a laser engine, a diode laser generates a beam that is reflected off a spinning, many-sided mirror. The beam is thus played across the width of the drum, and by rapidly turning the laser on and off, the individual dots may be placed to create the image.



With a light-emitting diode (LED) array, there are thousands of light points instead of a single source. Each pixel in the 300-dot-per-inch print line has its own tiny light that blinks on and off as the drum turns, exposing a tiny strip of drum and creating its own part of the image.



The liquid shutter (LCS) engine operates by a process that falls somewhere between the laser and the LED array. Like a laser, it has a single light source—often a halogen light. As in the LED array engine, every pixel is controlled individually. A vast array of liquid crystal shutters wink open and shut to let light through and expose the turning drum.



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rating of all presentation graphics software.\*

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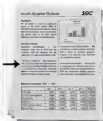
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**Spreadsheets**



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# software, they'd be Plus, and Manuscript.

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If you purchase both Freelance Plus and Manuscript and send in both Proof of Purchase coupons and sales receipts. To qualify, you must purchase the full retail version of Lotus Freelance Plus 3.0 (or 3.0i) or Manuscript 2.0 from a participating retailer. \*McGraw-Hill, April 1, 1989; PC Week, July 8, 1989. \*\*For more information about the "Perfect Fit" program and how Freelance Plus and Manuscript work with the new Lotus 1-2-3, call 1-800-343-5424.

PRINTERS  
LASER PRINTERS

PRINTRONIX L2324 REPORT  
EXPEDITER



PC  
FACT FILE

Printronix, 17500 Cartwright Rd., P.O. Box  
19559, Irvine, CA 92713; (800) 826-3874, (714)  
863-1900

List Price: \$15,500 (includes Supplies Cabinet  
base).

Dimensions (HWD): 15 x 48 x 28 in.  
Weight: 136 lbs.

Emulations: Diablo 630, HP LaserJet Plus  
In Short: Rated at 12 pages per minute, the  
costly LED-based L2324 is a last machine built  
for heavy usage. It works best as a shared printer  
for high-volume text output but produces only  
mediocre graphics.

CIRCLE 416 ON READER SERVICE CARD

the default fixed-font Courier and Line  
Printer typefaces. For each typeface, there  
is a wide variety of pitches and points in  
medium, bold, and italic. Unlike the HP  
LaserJet Plus, the L2324 can print any font  
in landscape or portrait mode.

There is no provision for additional  
memory; however, you can load up to 16  
fonts simultaneously in the standard 4MB  
of memory. Centronics parallel, RS-232  
serial (19,200 bits per second), and RS-  
422 serial (38,400 bps) interfaces are all  
standard.

HP LaserJet 500 Plus emulation is  
standard, and Diablo 630 emulation is  
available upon request. The LaserJet Plus  
emulation is flawed. The text output is of  
excellent quality but is not identical to the  
fonts of the HP LaserJet Plus it emulates.  
The L2324 doesn't conform to the HP La-  
serJet Plus high-order character set, and  
PC Labs tests revealed that the printable  
region is larger than that of the HP.

Unlike the text output, the graphics  
quality is mediocre. The test image didn't  
measure up to the crisper and more defined  
image produced by the standard HP.

The current installation manual is still  
in the "preliminary" stage even though  
the printer has been available for nearly a  
year. Its inadequacies made for a hellish  
installation experience, but the company

states that a revision will be released soon.

The Printronix L2324 has most of the  
essential qualities needed in a network  
printer: durability, speed, excellent print  
quality, and low maintenance. It will per-  
form admirably unless you require precise  
HP emulation, other emulations, or better  
quality graphics. But for the price, there  
are better values out there.

## QMS PS-820

by Alfred Poor

QMS has long been a leading advocate of  
affordable laser printing. So it should  
come as no surprise that the company has  
applied the two-tray Canon TX engine to  
PostScript applications, coming up with a  
\$6,495 offering. The price may not be the  
cheapest, but when you consider QMS's  
extras, it adds up to a worthwhile deal.

The best feature of the PS-820 is its dual  
paper trays. Each holds 200 sheets of pa-  
per, and you can either select the trays in-  
dividually or have them "chain" automati-  
cally, which allows you to print contin-  
uously without having to stop and add  
paper.

The printer is based on the well-known  
Canon laser engine, with its 8-page-per-

**The QMS PS-820  
is a little more expensive,  
but offers much  
more than a basic  
PostScript printer.**

minute rating and excellent print quality.  
Since the toner, developer, and drum all  
come in a single, sealed unit, maintenance  
is a snap.

The PS-820 is a breeze to set up. There  
are no front-panel controls; instead, there  
is a ten-position rotary switch on the back  
next to the cable connectors. By choosing  
one of the ten settings, you select between  
various preset configurations of interface  
and emulation. There are serial, parallel,  
and AppleTalk connectors—the Apple-

## QMS PS-820

### Fonts & Features

#### PostScript

	Helvetica	Times	Courier	Line printer
8/9-point	Bold	Bold	Bold	Bold
10-point	Bold	Bold	Bold	Bold
12-point	Bold	Bold	Bold	Bold
14-point	Bold	Bold	Bold	Bold
Scalable	Bold	Bold	Bold	Bold

#### HP LaserJet Plus

	Helvetica	Times	Courier	Line printer
8/9-point	Bold	Bold	Bold	Bold
10-point	Bold	Bold	Bold	Bold
12-point	Bold	Bold	Bold	Bold
14-point	Bold	Bold	Bold	Bold
Scalable	Bold	Bold	Bold	Bold

You can access the QMS PS-820's resident  
Adobe PostScript fonts in LaserJet mode.

Talk DB-9 connector doubles as an RS-  
422 port. In addition to the native Post-  
Script mode, you can also access Diablo  
630, HPGL plotter, and HP LaserJet Plus  
emulations.

The PS-820 performs well. The Post-  
Script tests ran smoothly, with well-  
formed characters and crisp graphics. The  
PostScript compatibility is not surprising,  
since the machine came with version  
4.2C of the real thing, Adobe PostScript.  
The LaserJet Plus emulation was nearly  
perfect; there was only one small problem  
with one of the macro commands on the  
torture test page. The PS-820 got other fine  
points right, however, such as assuming  
the correct default left margin and print-  
able page length. There are also some im-  
provements: you can access the PostScript  
fonts (including scaling) through the La-  
serJet emulation, so you have more font  
options than a LaserJet can give.

The PS-820 turned in respectable  
speeds as well. The LaserJet emulation  
times were within the range of Hewlett-  
Packard's times, and, at 7.4 ppm, the Post-  
Script timings were on par with other 8  
ppm PostScript machines.

The printer's documentation is excel-  
lent, with plenty of illustrations and step-  
by-step instructions. There are special sec-

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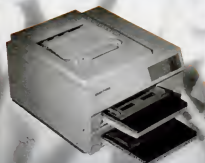
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CIRCLE 132 ON READER SERVICE CARD

# PRINTERS

## LASER PRINTERS

### QMS PS-820



#### FACT FILE

QMS Inc., One Magnum Pass, Mobile, AL 36618; (800) 631-2692, (205) 633-4300.  
List Price: \$6,495  
Dimensions (HWD): 12.75 x 32.5 x 18 in.  
Weight: 55 lbs.  
Emulations: Diablo 630, HPGL, HP LaserJet Plus, PostScript  
In Short: The PS-820 carries a list price a bit above basic PostScript printers, but it offers more features: HP LaserJet Plus and HPGL emulations, access to scalable fonts in LaserJet mode, plenty of interface options including AppleTalk, and flexible paper handling with two paper trays.

CIRCLE 410 ON READER SERVICE CARD

tions for connecting to a PC or a Macintosh. There is also some introductory material about PostScript and typography. A good glossary and thorough index make the manual even more useful.

The QMS PS-820 is a little more expensive than a basic entry-level PostScript machine, but it offers much more than a basic unit. The LaserJet and HPGL emulations have the potential to be extremely useful in some settings. The extra paper capacity and flexibility offered by the two paper trays may also be valuable to some users. As a result, if the PS-820's extras match your special needs, you are likely to find it a cost-effective and reliable solution.

## QMS PS-1500

by Alfred Poor

With a list price of \$7,995, the QMS PS-1500 costs about twice as much as the least expensive PostScript printers. But there's a reason: the PS-1500 gives you plenty more for your money in terms of speed, true Adobe PostScript, and some useful bundled utilities.

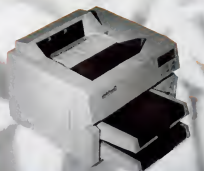
The most significant feature of this PostScript laser is the print engine: it's a big Ricoh model rated at a flashy 15 pages per minute. While the text speed results—at close to 9 ppm—didn't come close to that speed, the output timings were significantly above those produced by typical 8-ppm machines.

The Ricoh engine has other pluses. The two large paper bins hold 250 sheets each, giving you a full ream of paper on-line at once. The bins can be set so that the bottom will feed when the top runs out, eliminating the need to stop and reload paper. The engine produces solid black images with even toner coverage—a hallmark of Ricoh printer output.

Still, there are some flaws in the PS-1500's design. The toner goes in a drawer that slides into the front panel. There is no stop on the drawer, so if you pull too hard, you end up with toner down your front. Furthermore, I found it impossible to add toner to this bin without having at least a small amount escape. The photosensitive drum is also unprotected when you install it, leaving it precariously exposed to fingerprints and scratches that can ruin its print quality.

In all other respects, however, the PS-1500 shines. It comes with a range of connectors; in addition to the standard parallel and serial ports, you'll find AppleTalk, RS-422, and SCSI. The serial port supports communications speeds up to 38.4K bits per second. Setup is fairly straightforward, making use of front-panel buttons as well as messages that are displayed in a 16-character LCD window. Unfortunately, the manual could do a better job of docu-

### QMS PS-1500



#### FACT FILE

QMS Inc., One Magnum Pass, Mobile, AL 36618; (800) 631-2692, (205) 633-4300.  
List Price: \$7,995  
Dimensions (HWD): 16.75 x 21.25 x 26 in.  
Weight: 90 lbs.  
Emulations: HPGL (on-disk), PostScript  
In Short: The PS-1500 costs about twice as much as entry-level PostScript printers but offers more paper and more speed. It also comes with some useful utilities. Its biggest drawback is the loading of the toner and drum, but you get excellent-quality printouts once they are in place.

CIRCLE 409 ON READER SERVICE CARD

menting the choices, but any user with a little experience should be able to find the right settings with some experimentation.

The PS-1500 puts out excellent PostScript pages, drawing on a standard complement of 35 typeface outlines. Since the printer is loaded with Version 49.2B of licensed Adobe PostScript, the solid PostScript compatibility is not surprising. Furthermore, the printer backs this up with a full 4MB of memory plus 1MB of ROM on the controller.

QMS also bundles some useful utilities with the printer. *PS Executive* is a menu-driven program that helps you configure and test the printer; it also includes a utility that lets you execute a "print screen" on the printer. And there's an HPGL emulator that allows you to send output files to the printer in plotter format.

The QMS PS-1500 costs more than do many PostScript printers, but it offers more paper at a higher speed than most. Add the extra value of excellent print quality, genuine Adobe PostScript, and the bundled utilities, and the extra dollars are justified. If you can use the extra features that the PS-1500 offers, it's well worth consideration.

### QMS PS-1500

## Fonts & Features

	PostScript											
	Helvetica			Times			Courier			Line printer		
Bold												
Italic												
Underline												
8-9-point												
10-point												
12-point												
14-point												
Scalable												

The QMS PS-1500, which uses Adobe PostScript, comes with an HPGL emulator.

# From creation

# To completion...

Easily mix multiple type styles and sizes.

Versatile line spacing (6, 8 or 12 ppi, or any odd spacing you wish to preset).

Wide or narrow lines, check boxes and other symbols.

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Read existing dBASE files directly, or create new ones with up to 255 data fields per form.

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### Creation.

Make any form quickly and easily using **FormWorx with Fill & File.**™ Right on your own PC. No need for costly expenses and delays. Use large type for unmistakable headings, small type for inconspicuous labels. Proportionally spaced fonts or fixed-spaced type. Take full advantage of features on supported printers. Lines print perfectly straight and solid on dot matrix and laser printers. The result—business forms that truly look business-like.

### Completion.

Easily fill out forms right on screen and get letter-perfect results. Form after form. Simply tab from blank to blank and type in your data, or merge

data from existing dBASE or ASCII files. Entries go exactly where they belong. No overwrites. No misalignments. No "white-out."

Print data onto standard forms you already have in stock. Or form and data onto blank paper. Search and locate desired forms and automatically batch print them. Capture data the first time a form is filled out and store it in dBASE or ASCII format. Retrieve and edit data just as easily.

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Forms shown were printed using version 2.5 on an HP LaserJet II with downloaded fonts. Digitized logo printed within FormWorx by invoking a printer macro. Some features shown not available on all printers. **45-day money back guarantee on direct purchases.** When ordering by mail, include \$6.75 for shipping in U.S. and Canada. Air mail overseas—\$18. In Massachusetts add 5% sales tax. Purchase orders accepted from government agencies, institutions, and rated corporations. FormWorx with Fill & File is a trademark of FormWorx Corporation. dBASE is a registered trademark of Ashton-Tate.



## QMS PS-2200 Model S

by Alfred Poor

You may think that the "PS" in the QMS PS-2200 Model S stands for PostScript, but it may as well stand for "Printing Screamer." With a \$12,995 list price, this model, rated at 22 pages per minute, is one of the fastest printers ever to roll through PC Labs.

And "roll through" is no exaggeration. Tipping the scales at a heavyweight 107 pounds, this is not a printer you set up by yourself after work some evening. The QMS looks more like a midsize office copier than a desktop printer. Its recommended duty cycle of 20,000 pages per month (about one and a half reams a day) also sounds more like that of a copier than a printer, and the two 250-sheet paper trays mean you won't be changing paper often.

The main feature that will draw you to this printer is raw speed. In the PC Labs text speed tests, the PS-2200 turned in a blazing result of more than 15 ppm. Its graphics times were fast but not as dramatic; they broke the 100-second barrier but are not alone at that speed. The fast print engine is certainly one factor that makes the speed possible. Another is the 68020 processor on the controller that runs at a cool 16.67 MHz. This printer may well be more powerful than many computers that will be hooked up to it! Should you decide that you need more room for fonts and other files, you can even hook up an optional hard disk directly on the controller.

The engine, which QMS declined to identify, produces excellent toner cover-



age for solid black images. Since dark gray areas maintain their definition better without filling in to an all-black shade, grayscale pictures come out even better than on a Canon-engine printer.

The controller sports a full complement of input ports: parallel, serial, AppleTalk, RS-422, and SCSI. The serial port is capable of bit-per-second rates up to 57.6K for high-speed transmissions. A full 4MB of memory and another megabyte of ROM offer plenty of space for characters and page images. Some of this extra memory is required for composing large pages; the printer handles 11 by 17 paper, which it can fill to within a quarter-inch of each edge.

The ROM contains genuine Adobe PostScript, Version 51.0, and carries the typical set of 35 different font outlines. The resulting type is about as good as you'll find on a 300-dot-per-inch printer. Setup is easy, thanks to a simple front-panel design, a two-line LCD message window, and a clear menu system. If you need PCL or HPGL emulations, QMS offers the Model E (not tested here) for \$3,000 more.

There are other printers that cost about as much as the PS-2200. In general, these others offer higher-resolution output but

slower speeds. The QMS offering is the one to choose where speed is of utmost importance and 300-dpi resolution is sufficient. If you need to produce 11 by 17 output or need lots of PostScript pages in a hurry, the PS-2200 has to be one of the first machines on your list.

**Qume CrystalPrint  
Publisher**

by Alfred Poor

Last year, the Qume CrystalPrint WP—a tiny page printer with a tiny price to match—created a sensation. This year, the same box returns with new brains: the CrystalPrint Publisher is a little PostScript printer with a \$4,499 list price. Unfortunately, its speed doesn't match its reputation.

There are a few other PostScript printers with similar prices, but almost none are as small; the CrystalPrint's box takes up little more than a cubic foot. A single 100-sheet paper tray slides into the front. There is no manual feed, and facedown output is the only choice. The engine is also rated at a mere 6 pages per minute. With a text-speed result of barely more than 5 ppm, the CrystalPrint was one of the slowest black-and-white PostScript printers tested in this roundup.

The CrystalPrint Publisher is not a true laser printer, though you can't tell by looking at the case or the output. It uses the same sort of photosensitive drum and charged toner that a laser printer uses, but its light source is different. The printer is built around the Casio liquid crystal shutter

## QMS PS-2200 Model S Fonts & Features

## PostScript

[illegible]

**The QMS PS-2200 Model S contains the standard 35 Adobe PostScript fonts.**

## Qume CrystalPrint Publisher Fonts & Features

## PostScript emulator

[illegible]

The CrystalPrint Publisher's proprietary PostScript emulator produces type styles differing slightly from Adobe PostScript's.



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BubbleJet BJ130  
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Quietwriter III  
NEC Pinwriter  
Kyocera F Series  
Siemens PT90  
Intel Visual Edge System  
Toshiba 24-pln  
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Panasonic KX 24-pln  
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Akzidenz-Grotesk-Bold  
Akzidenz-Grotesk-Light-Extended  
Akzidenz-Grotesk-Normal-Extended  
Akzidenz-Grotesk-Medium-Extended  
Akzidenz-Grotesk-Bold-Extended

English Script  
English Script-Demi  
English Script-Bold

Goudy-Old-Style  
Goudy-Old-Style-Italic  
Goudy-Bold  
Goudy-ExtraBold  
Old-Town

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Requirements: IBM PC/XT/AT, PS/2 or compatible; DOS 3.0 or later; 640KB system memory (min. 550KB avail.); fixed disk; 1 or 2MB LIM EMS expanded memory RECOMMENDED; math coprocessor optional. Laser printers require minimum 1MB in printer to print a full letter-size page at 300 DPI. GoScript is a registered trademark of LaserGo, Inc. PostScript is a registered trademark of Adobe Systems, Inc. All other product names are trademarks of their respective manufacturers.



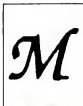
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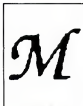
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**CIRCLE 335 ON READER SERVICE CARD**

# PRINTERS LASER PRINTERS

## QUME CRYSTALPRINT PUBLISHER



### PC FACT FILE

Qume Corp., 500 Yosemite Dr., Milpitas, CA 95035, (800) 223-2479.  
List Price: \$4,499  
Dimensions (HWD): 9 x 15.5 x 14.5 in.  
Weight: 35.2 lbs.  
Emulations: PostScript  
In Short: The list price is low, but no lower than that of some other serious competitors. Still, this printer is small and light and has a powerful RISC processor as well as some bonus typefaces. But in the end, its slow output speed makes it less attractive than the similarly priced competition.

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was noticeably darker on the CrystalPrint and the Palatino characters were lighter, especially in italics.

On the other hand, the CrystalPrint came with some bonus type styles built into the controller. Instead of the typical 35 fonts, there are 39; added are Helvetica Black and Helvetica Light, each in upright and oblique styles. As long as you don't have to match output precisely with that of a true PostScript printer, these extra type styles can be an attractive value.

In the end, the CrystalPrint Publisher's slow speed is its downfall. There are other printers for about the same list price with faster text and graphics speeds, plus true Adobe PostScript. If you need the extra space that the compact Qume will afford you or you want the extra four typefaces no matter what, then the CrystalPrint Publisher is worth consideration. If these are not compelling reasons, however, you will find a better bargain elsewhere.

## Raster Devices Direct Impression

by Alfred Poor

The Raster Devices Direct Impression is an unorthodox machine whose strengths make it difficult to evaluate. The system comes with drivers for *Microsoft Windows*, *GEM*, *Ventura Publisher*, and *Microsoft Word* (plus a new one for *WordPerfect 5.0* not included in the tested unit), which, unfortunately, the PC Labs printer benchmark tests are not designed to test.

### Raster Devices Direct Impression Fonts & Features

HP LaserJet Plus			
Helvetica	Times	Courier	Line printer
Bold Italic Bold-Italic Underline Sub-Underline	Bold Italic Bold-Italic Underline Sub-Underline	Bold Italic Bold-Italic Underline Sub-Underline	Bold Italic Bold-Italic Underline Sub-Underline
8.5-point			
10-point			
12-point			
14-point			
Scalable			

The Raster Devices Direct Impression comes with Bitstream font outlines and programs for making bitmapped typefaces.

## RASTER DEVICES DIRECT IMPRESSION



### PC FACT FILE

Raster Devices Direct, P.O. Box 5629, Hopkins, MN 55343, (800) 466-1732, (612) 941-4919.  
List Price: \$2,495; CAD-PAC (HPGL, AutoCAD, PLT, DXF) emulation software, \$295.  
Dimensions (HWD): 8 x 25.5 x 17.5 in.  
Weight: 37.5 lbs.  
Emulations: HP LaserJet Plus  
In Short: The Impression is of interest only if you use one of the applications supported by its special drivers. Its limited and flawed LaserJet Plus emulation is of questionable utility and may lead to problems with some programs.

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(LCS) engine, which uses a halogen light behind a series of liquid crystal cells.

The printer produces good images, with even toner distribution over solid black areas. The single flaw in print quality showed up in the dark gray areas, which tended to fill in a bit, becoming darker than they should have been and losing some definition.

The printer's controller is also a bit unusual. It uses the Weitek RISC processor, a 32-bit chip that is rated at 4 mips and is designed from the ground up to work in fast controllers for page description languages. It is backed up by 3MB of memory in the CrystalPrint Publisher.

The CrystalPrint Publisher does not run Adobe PostScript. It uses Qume's own emulation, which the company claims is compatible with Version 47.0 of PostScript. No command-compatibility problems showed up on PC Labs tests of the printer, which came with Version 3.00 ROMs installed. The typefaces were not quite the same as Adobe PostScript's; when compared with the test output from a half-dozen true PostScript printers, the CrystalPrint Publisher's text was visibly different. For example, the Courier font

The \$2,495 laser printer also offers HP LaserJet Plus compatibility, but with mixed results.

The Impression comprises three separate components: a stripped Ricoh 1060 6-page-per-minute laser print engine, a two-thirds-length interface card for your PC, and at least 3MB of data and programs that you download onto your hard disk. The controller card, which is the key to this printer, doesn't have PostScript or PCL or, for that matter, any other standard emulation. It is actually a special card manufactured by LaserMaster for Raster Devices. LaserMaster makes an add-on controller for Canon engine printers, called the CapCard, which uses the same software as the Impression.

The software consists of Bitstream font outlines and programs that can use them to generate bitmapped font files. Other software includes configuration utilities, a LaserJet emulation program, and a TSR that intercepts output and sends it to the controller card. The real strength of the system is its application-specific drivers, which give you features and special effects that rival those found in PostScript. According to Raster Devices, these drivers end up making the Impression much faster

## LASERMASTER 1000: Typesetter-Quality 1,000 by 400 dpi

by Edward Mendelson

If the LaserMaster 1000 were invited to a masquerade party, it wouldn't have to put on a disguise. When you see it sitting on a desktop, it looks exactly like any run-of-the-mill clone of the 300-dot-per-inch HP LaserJet Series II. The surprise comes when you pick up a sheet of paper from its output tray. The LaserMaster 1000 produces 1,000- by 400-dpi (horizontal by vertical) output that's virtually indistinguishable from that of a \$30,000 typesetter, and it does so at the astonishing rate of 4 or 5 pages per minute—or more. The quality of the type, using scalable Bitstream fonts, is by far the best you can find on a desktop, and the reproduction of the graphics and halftones is so close to the best that the difference is completely insignificant.

The LaserMaster 1000 consists of two separate units: the \$2,500 printer itself and a controller card that sits in your computer. The controller card, which carries 6MB of RAM, costs \$4,995 for AT-bus and \$5,495 for Micro Channel machines. Connected by a thick cable supplied with the printer, this combination produces comparable text quality and a graphics output almost as good as that from the 600-dpi Varityper VT600P (reviewed here), which costs more than twice as much.

The LaserMaster 1000 is built around a special Canon engine that doesn't have a model number but looks identical to the workhorse 386SX en-

gine in the LaserJet Series II. The engine is hot-rodged by Canon to achieve a vertical resolution of 400 dpi, and the electronics on the controller card increase the horizontal resolution to 1,000 dpi. The vertical resolution is limited by the mechanism that rotates the drum and can't be increased until the arrival of a wholly new generation of laser engines.

You won't buy the LaserMaster 1000 to use as a glorified typewriter. As shipped, you can use it only with *PageMaker* and other *Windows* applications, *Ventura* and other *GEM* applications, *AutoCAD*, *WordPerfect*, and *Microsoft Word*. The *WordPerfect* and *Word* drivers are limited to 400 by 400 dpi, but all the others allow full 1,000 by 400 resolution. A Presentation Manager driver will be available soon, and more DOS drivers are on the way from Z-Soft and other vendors.

The LaserMaster 1000's dependence on these drivers is the reason we excluded it from the regular reviews in

this issue. One of our requirements was that a printer come with at least one of the standard PC printer emulations: Apple LaserWriter (PostScript), IBM Graphics, IBM Proprinter, Epson, HP LaserJet, and Diablo. The LaserMaster 1000 doesn't have any of them.

The drivers communicate to the printer via a 30K TSR. The *Windows* and *Ventura* drivers load the TSR directly, but with *WordPerfect* and *Word* they have to be loaded via a batch file. If you have a 386 computer, you can use a memory manager like *QEMM-386* or *386-to-the-Max* to load the TSR in high memory so it doesn't take a bite out of DOS's 640K.

The LaserMaster comes with 35 Bitstream fonts equivalent to the 35 fonts supplied with most PostScript printers. Store the outlines and other control software on your hard disk, then load them on to the controller through a command in your AUTOEXEC.BAT. On a 386 machine, the software takes only 2 to 3 seconds to load. You can convert Bitstream's *Fontware* typeface outline into a LaserMaster font. By default, LaserMaster fonts use the standard PostScript character set, but a utili-

\$7,495 PostScript 1,000- by 400-dpi laser and controller card



than either an Apple LaserWriter or a LaserJet Series II.

But without these drivers, the Impression ran our tests rather slowly: it took about 4 ppm while printing text, and it required a full 2 minutes to complete the graphics image. The HP emulation is incomplete: it doesn't correctly produce a Line Printer typeface (it uses a proportional font instead), and it also fails to support some of the fundamental PCL commands, including macros as well as the proportional-spacing command. It passed most of the PCL torture-test challenges; however, on

one try the page prompted the controller to perform a dump of its font memory.

The package has other troubles. The documentation looks good in its attractive binder with slipcase, but the information is not always presented clearly, and in some cases it is simply wrong. For example, the installation instructions direct you to install the software so that it uses a port other than the one installed in your computer. When I couldn't get the PC Labs benchmark tests to produce output, the Raster Devices technical support representative instructed me to reinstall the software so it would ad-

dress the same port that existed in the machine. This was a direct contradiction to the manual, but it solved the problem. Beyond this conflict with support, the manual doesn't make it clear that not all the LaserJet Plus commands are included in the emulation. This is essential information; without one command, the controller failed to find the Line Printer font as part of the benchmark tests and found a proportional font instead.

The bottom line is that the Raster Devices Direct Impression holds forth the promise of a fast printer with as much for-

ty now in the works will let you use any of more than 500 characters in the complete Bitstream symbol set.

LaserMaster's *PageMaker* and *Venara* drivers give you all the flexibility of PostScript at much greater speed. LaserMaster's special effects include fonts scalable up to 1,200 points—even if the application won't directly support large-size type. Text in any Bitstream typeface can be stretched, slanted, sheared, sloped, flipped, rotated, or filled in with any pattern you like. And you can place type against virtually any kind of shaded or patterned background. These special effects aren't visible on-screen unless you use one of LaserMaster's own EGA controllers, but they print perfectly.

Encapsulated PostScript files can't be printed directly from an application, but with a separate utility, PostScript print files can be printed from the DOS command line. The translation is more exact at 400 by 400 dpi than at 1,000 by 400, but that's still almost twice the resolution of most desktop PostScript printers. A similar utility lets you print HPGL files.

The LaserMaster's 1,000- by 400-dpi output looks slightly better in portrait than in landscape mode. This is because the letters of the Roman alphabet are shaped so that high horizontal resolution makes more of an impact than high vertical resolution. In landscape mode, the benefit of 1,000 dpi is somewhat wasted on the vertical axis, where it does less good.

The only headache with the LaserMaster's graphics comes the first time you print a TIFF file in *PageMaker*.

Unless you use the *PageMaker* image control to adjust the number of scan lines to about 90 per page, the output won't look very good. Unfortunately, the manual does not do an adequate job of explaining this problem.

Without the standard PC emulations, PC Labs speed tests could not be performed formally. In informal testing, the LaserMaster achieved speeds of 4 or 5 ppm for text and small-scale graphics at 1,000 by 400 dpi. You can increase the speed to 8 ppm by printing at 400 by 400 dpi. Graphics inevitably slow down printing, but by a far smaller degree than in most PostScript and all LaserJet-compatible printers.

Although it looks like a laser printer, the LaserMaster 1000 is in fact the first plain-paper typesetter that fits on your desktop. Its output is far better than that from printers selling at twice the price, but without a speed penalty. The LaserMaster 1000 doesn't emulate other printers—and it doesn't need to because nothing approaches its combination of price, convenience, and above all, quality. ■

#### LaserMaster 1000

LaserMaster Corp., 7156 Shady Oak Rd., Eden Prairie, MN 55344; (612) 944-6069.

**List Price:** Printer unit, \$2,500; standard bus controller, \$4,995; Micro Channel architecture controller, \$5,495. **Dimensions:** 16 x 19 x 6.5 in. **Weight:** 38 lbs. (printer only). **Emulations:** PostScript emulator. Utilities for printing PostScript and HPGL print files are included.

CIRCLE 943 ON READER SERVICE CARD

## Ricoh PC Laser 6000/PS

by Alfred Poor

How you see the Ricoh PC Laser 6000/PS depends on your perspective: given its list price of \$4,495, you can see it either as an expensive 6-page-per-minute laser printer or as an inexpensive PostScript printer. There is a bit of truth to both points of view, but neither adds up to an outstanding value.

The 6000/PS is based on the widely used Ricoh 1060 engine, which has a

6-ppm rating and a bad reputation caused by some problems with early versions of the engine. The engine model used in the 6000/PS has undergone improvements in some important areas, including changes to the developer, toner units, and power supply.

The print engine uses separate toner, developer, and photosensitive drum components. These pieces interlock in a frame in the base of the engine, but the arrangement has a flimsy feel to it. One aspect of this engine that I particularly dislike is that

### Ricoh PC Laser 6000/PS Fonts & Features

	PostScript				HP LaserJet II			
	Helvetica	Times	Courier	Line printer	Helvetica	Times	Courier	Line printer
	Bold	Bold	Bold	Bold	Bold	Bold	Bold	Bold
	Italic	Italic	Italic	Italic	Italic	Italic	Italic	Italic
	Sub-Script	Sub-Script	Sub-Script	Sub-Script	Sub-Script	Sub-Script	Sub-Script	Sub-Script
	Underline	Underline	Underline	Underline	Underline	Underline	Underline	Underline
6/9-point								
10-point								
12-point								
14-point								
Scalable								

	PostScript				HP LaserJet II			
	Helvetica	Times	Courier	Line printer	Helvetica	Times	Courier	Line printer
	Bold	Bold	Bold	Bold	Bold	Bold	Bold	Bold
	Italic	Italic	Italic	Italic	Italic	Italic	Italic	Italic
	Sub-Script	Sub-Script	Sub-Script	Sub-Script	Sub-Script	Sub-Script	Sub-Script	Sub-Script
	Underline	Underline	Underline	Underline	Underline	Underline	Underline	Underline
6/9-point								
10-point								
12-point								
14-point								
Scalable								

The Ricoh PC Laser 6000/PS comes with the 35 standard Adobe PostScript fonts.

the fragile drum is not protected from scratches during installation. On the other hand, the printer offers faceup and facedown output, with cassette and manual paper feed, and it has a straight-through paper path available for thicker paper.

While the 6000/PS uses an inexpensive engine, it doesn't cut corners in its controller. It uses genuine Adobe PostScript, Version 50.5, complete with the full complement of 35 standard typeface outlines in ROM. The controller is driven by a Motorola 68000 CPU running at 16.67 MHz and has a full 2MB of RAM at its disposal. If needed, you can even upgrade the memory to 4MB.

The controller is flexible as to how it gets its data; you can use parallel, serial,

matting power as a PostScript printer or more, but at the price of a LaserJet clone. Actually, this promise can only be realized using the programs supported by its drivers. Since we were not able to test these drivers with PC Labs benchmark tests, I cannot report on their value. If you intend to rely on the LaserJet Plus emulation, however, you may be disappointed. Ultimately, you should get this printer only if you plan to use it almost exclusively for applications supported by its custom drivers and if you are willing to take a risk in order to save some money.

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LaserJet IIP \$1495;  
LaserJet Series II \$2695.  
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HEWLETT  
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CIRCLE 305 ON READER SERVICE CARD

AppleTalk, or RS-422A interfaces to make the connection to your computer. Even the printer command set is flexible: the 6000/PS has HP LaserJet Series II emulation included as a standard feature.

In terms of performance, the results were about what might be expected, given the engine's specs. The PostScript graphics times were a bit slower than those of most 8-ppm competitors, as were its LaserJet-mode graphics (though the 6000/PS LaserJet mode was much faster than its PostScript mode). In the text speed test, both modes clocked in at between 5 and 6 ppm, in line with the engine's rating but no match for 8-ppm machines.

One of the biggest disappointments with the 6000/PS is its implementation of the LaserJet mode. As far as it goes, it does an excellent job of emulating the original; it passed the PC Labs torture test without difficulty. Unfortunately, the Ricoh engineers opted to slavishly copy the LaserJet's capabilities, even to the point of limiting the 6000/PS: you can't access any of the advantages of the PostScript side from the LaserJet mode. You get only the Courier and Line Printer fonts found on a Series II, and can't get at the Times Roman or other useful PostScript typefaces. You also cannot resize the fonts in LaserJet

mode. Other PostScript printers that offer LaserJet emulation include all these extra capabilities, and the value of the Ricoh 6000/PS is diminished by their absence.

But the biggest problem this printer faces is its price. There are other PostScript machines on the market at similar prices with faster engines and more features. As a result, the 6000/PS falls short of the mark, and you will find better value in a low-end PostScript printer elsewhere.

## Spear Desktop Laser Printer

by Edward Mendelson

Imagine a printer with the functions of the HP LaserJet Series II, but less solid in construction and less convenient in design, and you'll know what to expect from Spear Technology's \$1,355 Desktop Laser Printer. And if you've already read the reviews of Desktop Systems' Desktop Laser Beam printer, the Epson EPL-6000, and the Mannesman Tally 905—all of which are based on a TEC engine—you'll have an even better idea of what to expect: the four are strikingly similar. Spear's model sports the lowest price tag.

The TEC engine used in the Spear Desktop Laser Printer produces blacks as solid and dark as—if not a bit darker than—the Canon SX engine's. Along with this printer's attractively small footprint and attractively small price come some unattractively annoying small problems.

The printer's size may be its best feature. It occupies a mere 16-inch square of desktop real estate, although the 100-sheet paper cassette extends 8 more inches from the right-hand side. But the printer's lightweight construction has a distinctly flimsy feel. Without much provocation, the plastic top of the cassette tray cracked in the first hour of testing.

The paper path, like that of the LaserJet Series II, drops the output face down in the top panel. By pressing a lever, you can switch to a straight path that exits from a slot on the left side. The printer doesn't come with a tray to catch the straight-through output, so you'll have to either let the paper fall on your desk or buy an optional tray from Spear. Spear hasn't yet settled on the tray's cost.

The TEC engine uses a separate toner cartridge and drum—a much less conve-

nient system than Canon's. A \$65 toner cartridge should last about 1,500 pages before it needs replacement; the drum, whose replacement price wasn't set at the time of this review, should last about 10,000 pages. The printer's 512K RAM is standard; Spear's proprietary memory boards will let you add 1MB, 2MB, or 4MB. Until the TEC engine becomes more common in the marketplace, you may need to go directly to Spear for supplies.

Spear builds LaserJet Series II emulation into the printer, so you can plug virtually any font cartridge into its two slots or download any standard soft font. You can also make use of the slots for an optional emulation cartridge to make the printer act like either a Diablo 630, Epson FX-80 Plus, or IBM Proprinter XL, depending on which \$149 cartridge you choose. You can then switch emulations using one of the membrane buttons on the control panel.

The Spear's built-in LaserJet II emulation produced mixed results on PC Labs tests. It printed solid, consistent text and graphics approaching the quality of the second-generation Canon engine. But its speed was another matter; the graphics file took almost a minute and the 20-page text file printed at a leisurely 5.2 pages per minute (Spear claims 6 ppm). In addition,

### Spear Desktop Laser Printer Fonts & Features

HP LaserJet II											
Helvetica	Times	Courier	Line printer								
Bold	Bold	Bold	Bold	Bold	Bold	Bold	Bold	Bold	Bold	Bold	Bold
Italic	Italic	Italic	Italic	Italic	Italic	Italic	Italic	Italic	Italic	Italic	Italic
Underline	Underline	Underline	Underline	Underline	Underline	Underline	Underline	Underline	Underline	Underline	Underline
8-9-point											
10-point											
12-point											
14-point											
Scalable											

The Spear Desktop Laser Printer comes with Bitstream fonts but accepts HP-compatible font cartridges and soft fonts.

the printer stumbled badly over the LaserJet-emulation torture test: the LED display flashed its standard "Processing" message, but the printer never bothered to print the file.

Spear's technical staff suggested one or two solutions that didn't work. Finally, by mere accident, I found that about three-fourths of the first page of the file would print after I switched off the computer.

**RICOH PC LASER 6000/PS**

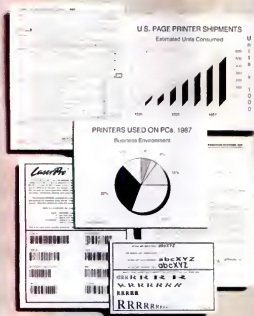


**PC FACT FILE**

Ricoh Corp., Peripheral Products Division, 3001 Orchard Pkwy., San Jose, CA 95134; (800) 447-4264, (408) 432-8800.  
List Price: \$47,495  
Dimensions (HWD): 9.25 x 25 x 16.5 in.  
Weight: 37 lbs.  
Emulations: HP LaserJet Series II, PostScript  
In Short: The 6000/PS has plenty of good features, but its slow Ricoh 6-ppm engine and limited LaserJet-emulation mode cut into its appeal. Its list price isn't low enough to make it a compelling value when compared with other low-end PostScript competitors.

CIRCLE 424 ON READER SERVICE CARD

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# PRINTERS LASER PRINTERS

## SPEAR DESKTOP LASER PRINTER



### PC FACT FILE

Spear Technology, 710A Landwehr Rd., Northbrook, IL 60062; (800) 282-1212, (312) 480-7300.

List Price: \$1,355; Diablo 630, Epson FX-80 Plus, IBM Proprinter XL emulation cartridges, \$149 each.

Dimensions (HWD): 8.3 x 24.5 x 16.5 in.

Weight: 35 lbs.

Emulations: HP LaserJet Series II

In Short: Spear's compact, inexpensive printer is an imperfect imitation of the LaserJet Series II; it could not print the PC Labs LaserJet emulation file. Text prints at a slow 5.2 ppm. Separate toner cartridges and photoconductors are an unnecessary inconvenience, and supplies may be hard to get unless you order directly from the vendor. You may want to wait for next year's version of this TEC-based laser.

CIRCLE #18 ON READER SERVICE CARD

Turning off the printer to eject the test page worked consistently in PC Labs, but you may not find it a practical method for real-world applications.

Spear suggested that the problem with the emulation test page resulted from differences between the ways the Desktop Laser Printer and the LaserJet manage their internal buffers. A more likely explanation may be that the Spear emulation can't handle LaserJet macros—a deficiency also uncovered in tests of the TEC-based Mannesmann Talley 905. The section of the test file that finally came out of the printer stopped exactly at the point where the file used a macro to print a vertical line. Most applications don't use PCL macros when printing on a LaserJet, but this printer may give you problems if you use an application that does.

The manual presents other problems. The diagram of the control panel doesn't match the descriptive text, and neither the diagram nor the text matches the control panel on the printer itself. Information on the control panel's configuration menu is

confusingly scattered among different sections, and some of the diagrams either lack captions or obviously don't belong with the adjacent text.

The printer's internal fonts correspond to the ones in the LaserJet II: Courier, Courier Bold, and Line Printer in portrait and landscape. The fonts are generally a close match to HP's, although the copyright and registered symbols are squashed ovals instead of circles. The printer ships with ten disks of Bitstream soft fonts, comprising portrait and landscape equivalents of Times Roman and Helvetica in sizes from 6 to 30 points in normal, italic, and bold styles.

Spear's customers get 90 days of on-site service, as well as copies of Insight Development's *Laser Control* and *Laser Plotter* software packages. *Laser Control* downloads and selects fonts; it also lets you emulate standard dot matrix and daisy wheel printers using a TSR converter instead of one of the optional emulation cartridges. If you use up-to-date applications, you won't need it. *Laser Plotter* lets you print plotter output on a laser printer, but you have to print the output to disk first.

Despite its problems, the Desktop Laser Printer may be worth considering if you have neither a wide desk nor a thick wallet, and if your printing needs are so basic that you don't need to worry about arcane points of compatibility. Otherwise, you may want to let the TEC engine mature a bit longer before falling on this Spear.

## Talaris 1590-T Printstation

by Trudy Neuhaus

Weighing in at 95 pounds and carrying a list price that starts at \$7,990, the Talaris 1590 Printstation, rated at 15 pages per minute, is a formidable contender in the printer-sharing or LAN division.

Out of the box, the 1590-T supplies 43 standard fonts, 3MB of memory (expandable to 5.5MB), and emulations for the Hewlett-Packard LaserJet Series II, DEC LN03 Plus, Tektronix 4014, and Diablo 630 ECS, as well as a straight ASCII dump. You can choose a serial, parallel, SCSI, or Ethernet interface.

We tested the 97-pound 1590-T "Turbo" model (\$9,490), which boosts the 34010 Graphics System Processor (GSP)

## Talaris 1590-T Printstation Fonts & Features

### PostScript emulator

	Helvetica	Times	Courier	Line printer
Bold				
Italic				
Underline				
8.9-point				
10-point				
12-point				
14-point				
Scaleable				

### HP LaserJet II

	Helvetica	Times	Courier	Line printer
Bold				
Italic				
Underline				
8.9-point				
10-point				
12-point				
14-point				
Scaleable				

The Talaris 1590-T Printstation comes with a 43-font PostScript emulator in firmware.

speed from 40 to 50 MHz (both models use a 10-MHz 32016 CPU) and increases the memory to its maximum of 5.5MB. Of that memory, 512K is user-configurable for dynamic font and macro storage. The PostScript emulation option for the 1590-T adds another \$2,000 to its cost. This option includes 35 PostScript fonts, Adobe-compatible CAL PostScript in firmware, and a \$950 32MB external hard disk.

Once the 1590-T is configured, all options are selectable through software in the users' computers, so each person on the network can customize the output. Its three well-organized and well-illustrated manuals contain frequent and helpful summary reference tables. Initial setup, however, proved trying. Even with the help of nine LED indicators and a 16-character LCD readout on the control panel, operating the five membrane push buttons that configure the printer was anything but intuitive. Between referring to the manuals and the aid of a helpful technical support staff at Talaris, we were able to get the Printstation up and running in its standard printer setup, but the job is clearly designed for an MIS or IC professional.

The Talaris 1590-T scored well above average on PC Labs speed tests. In the HP LaserJet Series II emulation, it clocked

## PRINTERS LASER PRINTERS

### TALARIS 1590-T PRINTSTATION



#### PC FACT FILE

Talaris, 6059 Cornerstone Court West,  
P.O. Box 261580, San Diego, CA 92126, (819)  
587-0787

List Price: \$9,490, with 5.5MB of system  
memory and PostScript option (including 35  
fonts, firmware, and a 32MB external  
hard disk), \$11,490

Dimensions (HWD): 16.75 x 21.25 x 25.75 in.  
Weight: 97 lbs

Emulations: DEC UN3 Plus, Diablo 630 ECS,  
HP LaserJet Series II, Tektronix 4014

In Short: The Talaris 1590-T is fast and flexible. It  
comes standard with 43 fonts and has several  
emulation modes. Interfaces include serial,  
parallel, SCSI, and Ethernet. This one's a good  
bet for a LAN or other printer-sharing  
environment.

CIRCLE 408 ON READER SERVICE CARD

13.4 ppm in the text speed test and took  
2.2 minutes to print the graphics page. In  
PostScript mode, it scored 11.02 ppm for  
text and took 14.87 minutes to produce the  
graphics image.

The 300- by 300-dot-per-inch graphics  
and text output, in both the LaserJet II and  
PostScript modes, was clear and crisp.  
However, a close look at the graphics  
printed in the LaserJet II mode revealed  
that the dark areas were less solid than  
those in the LaserJet's output. Similarly,  
the lighter areas were that much lighter and  
thus tended to lose the pattern. The Post-  
Script output produced blacker blacks, and  
the edges were smoother. Overall, the text  
and graphics resolution in both emulations  
was very high.

The 1590-T goes beyond the fonts of  
the LaserJet Series II and offers 8-, 10-,  
12-, 18-, and 28-point Swiss (Helvetica);  
10- and 12-point Courier; and Line Printer.  
Further, the printer's GSP adds enhance-  
ments on the fly. Additional font car-  
tridges are available for \$375 to \$775 per

set. If you wish, the manufacturer will load  
the fonts directly onto the hard disk at no  
extra charge. Currently, there are no addi-  
tional fonts available in PostScript.

Two interchangeable 250-sheet letter-  
size trays are standard equipment. In addi-  
tion, the 1590-T can handle legal-size,  
half-letter-size, and the European A4-size  
paper. An optional 1,000-sheet bin is  
available for \$795; legal-size trays cost  
\$95. Minimum and maximum recom-  
mended paper weights are 16 and 24  
pounds, respectively.

The manufacturer's rated printer life  
expectancy is 1.5 million pages. Mainte-  
nance is suggested at 25,000-copy inter-  
vals (approximately one month), and toner  
should be replaced every 3,000 to 5,000  
copies. Excluding maintenance, the  
claimed cost per page is 3.8 cents.

The Talaris 1590-T Printstation is a  
fast, ambitious printer. Its built-in flexi-  
bility makes it well suited for office environ-  
ments that need more than one type of  
printer emulation or need to connect more  
than one type of computer to a common  
printer.

## Unisys AP 9206

by Alfred Poor

The Unisys AP 9206 carries a list price of  
\$2,995 and comes with a host of standard  
features. While it is an extremely flexible  
machine, you need to look carefully to see  
if its extras will ultimately be useful in your  
applications and justify its price.

The printer is built on the familiar Ric-  
oh 1060 laser print engine. Rated at 6  
pages per minute, this compact unit offers  
good print quality. The toner coverage is  
generally even across large areas of black,  
though our test unit did show signs of thin  
spots on some of the benchmark test  
pages. The paper handling is flexible, with  
both manual and 150-sheet cassette feed,  
and allows both faceup and facedown out-  
put.

But the heart of the Unisys AP 9206 is  
its highly flexible controller. It's based on  
Office Automation Systems' Express lan-  
guage, which offers a variety of interesting  
features. For example, it includes a num-  
ber of graphics primitives commands that  
make it easy to create lines, polygons,  
arcs, circles, patterns, and even pie charts.  
You can create bar codes in 39 different  
formats with a simple text command.

The AP 9206 controller also comes  
with fonts—lots of fonts. There are 22 dif-  
ferent type styles, each of which can be  
printed in any of 21 different attribute  
combinations, such as bold italic portrait  
or double-vertical landscape. These com-  
binations can use any of 41 character sets,  
which draw on a pool of 375 different  
characters. Not all of these combinations  
are available in all emulations, but you get  
plenty of variety all the same. And the Ex-  
press language contains some basic font  
outlines as well, which you can use to cre-

### Unisys AP 9206 Fonts & Features

	HP LaserJet Plus				IBM Proprinter XL			
	Helvetica	Times	Courier	Line printer	Helvetica	Times	Courier	Line printer
8.5-point	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
10-point	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
12-point	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
14-point	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Scalable	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

	IBM Proprinter XL			
	Bold	Italic	Subscript	Underline
10 dpi	Yes	Yes	Yes	Yes
12 dpi	Yes	Yes	Yes	Yes
Compressed	Yes	Yes	Yes	Yes
Proportional	Yes	Yes	Yes	Yes

The Unisys AP 9206 can apply 21 different  
attributes to 22 different typefaces.

ate new fonts with near-infinite variety.

Not many programs offer Express driv-  
ers, however, so the AP 9206 is designed  
to handle a variety of configurations.  
It comes with four different printer emu-  
lations: IBM Proprinter XL, Epson FX, Dia-  
blo 630, and HP LaserJet Plus. These  
choices mean that you should be able to  
run the printer with nearly any program on  
your shelf. Save room on that shelf for the  
AP 9206 documentation; it comes in seven  
manuals.

The emulations themselves are not per-  
fect. The character sets used are not exact  
matches for the original printers, primarily  
in the higher-order characters. In the Pro-  
printer emulation, the first line of the test  
graphic was offset horizontally. Also, the



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## PRINTERS LASER PRINTERS

### UNISYS AP 9206



#### PC MAGAZINE FACT FILE

Unisys Corp., Box 500, Bluebell, PA 19424; (215) 542-2240  
**List Price:** \$2,995  
**Dimensions (HWD):** 9.25 x 32.5 x 16.25 in.  
**Weight:** 37.5 lbs.  
**Emulations:** Diablo 630, Epson FX-80, HP LaserJet Plus, IBM Proprinter XL  
**In Short:** Packed with fonts and features, the AP 9206 looks good at first, but flawed emulations, nonstandard fonts, and slow print speed make its relatively high list price less attractive than that of some competing choices.

CIRCLE 426 ON READER SERVICE CARD

AP 9206 failed the PCL torture test page because it couldn't handle the downloaded font. According to a Unisys representative, the company knows the cause of this difficulty and is preparing a revision for release later this year.

Then there is the issue of speed. A \$3,000 list price is not uncommon, nor are 6-ppm printers. However, the combination does not make for a particularly appealing value. The AP 9206 clocked a steady and respectable 5.8 ppm in all three tested emulations, but this is slow for the asking price.

The Unisys AP 9206 is a near miss. It makes an effort to compensate for slow speed and a relatively high list price by adding lots of extra features. Unfortunately, the extra fonts are of mixed value, and the emulations are not totally reliable. There are other printers available for basic applications that cost less or print faster, or both.

## Unisys AP 9215-1

by Alfred Poor

The basic Unisys AP 9215-1 comes with a list price of \$5,995 and only the Diablo 630 emulation mode, making it little more than a fast daisy wheel equivalent. Add the \$290 LaserJet Plus emulation option and you've got something—HP compatibility

and a \$6,285 price tag. Why would you pay about two and a half times as much as for a real LaserJet? The main reason is speed; rated at 15 pages per minute, the AP 9215-1 turned in an impressive 13.4 ppm on the PC Labs text speed test—nearly twice as fast as a typical 8-ppm-rated laser printer.

The LaserJet Plus emulation comes on a ROM card the size and shape of a credit card. The card slips comfortably into a slot in the back of the printer, near the parallel and serial connectors.

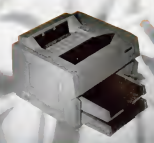
The AP 9215-1 with the emulation comes with ten different fonts, each available in portrait or landscape orientation. These include Courier in 10 and 12 pitch, Prestige Elite, Letter Gothic, and Orator. You even get three proportional fonts: Century, Boldface, and Bold Italic.

The emulation is good. It passed our PCL torture-test page with only three picky problems: the 2 percent shade was too light, the left margin was closer to the left edge of the page than on a LaserJet, and some of the higher-order characters were missing.

The print quality is excellent, with solid black images and even toner coverage—largely the result of using the Ricoh 4150 laser print engine. In addition to high speed and good imaging, this engine also accommodates two paper bins, which each hold 250 sheets.

The print engine is also the start of some of the problems with the AP 9215-1. Toner is separate from the drum and is installed in a drawer that can be tugged clear from the printer all too easily. Furthermore, I found

### UNISYS AP 9215-1



#### PC MAGAZINE FACT FILE

Unisys Corp., Box 500, Bluebell, PA 19424; (215) 542-2240  
**List Price:** \$5,995; Epson FX-80, HP LaserJet Plus, IBM Proprinter emulation cards, \$290 each  
**Dimensions (HWD):** 16.75 x 21.25 x 26 in.  
**Weight:** 86 lbs.  
**Emulations:** Diablo 630  
**In Short:** Although it offers high printing speed, good image quality, and a batch of fonts, the AP 9215-1 is no bargain when you add up its limited emulations and other shortcomings and match them with its relatively high price.

CIRCLE 427 ON READER SERVICE CARD

it impossible to add toner without at least a small amount escaping from the bin. The drum is a flexible belt that is dangerously exposed to scratching and mishandling during installation. There is no manual feed option, no envelope handling, and no straight-through paper path for heavier paper stocks.

The controller itself has problems. For this price, you might expect to get a bunch of good fonts with the HP LaserJet Plus emulation. Instead, the ones that come with the card are nothing but a collection of reshaped daisy wheel fonts. And the fonts that are included don't even offer a full Roman-8 character set such as that found on the LaserJet. There is no set equivalent to the IBM character set either, which many programs use for line drawing but which won't work here.

All told, the Unisys AP 9215-1 comes up short. If you need a printer that is compatible with the HP LaserJet Plus (or better yet, the Series II) with twice the speed and twice the paper capacity for twice the price of a LaserJet, then buy two LaserJet Series II printers. They're a better bargain than just one of these.

### Unisys AP 9215-1

#### Fonts & Features

	HP LaserJet Plus									
	Helvetica	Times	Courier	Line printer						
	Bold	Swiss	Underline	Bold	Swiss	Underline	Bold	Swiss	Underline	Bold
8.5-point										
10-point										
12-point										
14-point										
Scalable										

The Unisys AP 9215-1's LaserJet emulation comes with ten different fonts, each available in portrait or landscape.

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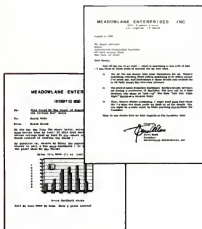
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CIRCLE 235 ON READER SERVICE CARD

The output samples above were printed on a MICROLINE 380 using WordPerfect 5.0 and Genograph.

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## Unisys AP 9230

by M. David Stone

**Question:** What's bigger than a kitchen stove, weighs more than most pieces of office furniture, and has three times the print speed of an HP LaserJet Series II? **Answer:** the Unisys AP 9230, a \$19,500 printer with an impeccable pedigree and a measured speed of better than 22 ppm. Clearly, this is not a printer for everyone. At first glance it looks more like an office copier. And with a monthly duty cycle of 30,000 to 60,000 pages, it's just as clearly intended for the same kind of heavy-duty use.

The most immediately obvious attribute of the AP 9230 is its massive bulk. The printer itself measures roughly 18 by 27 by 26 inches (HWD). But that's before you add the paper stacker, the printer stand, and assorted input and output trays. The stacker is a clever device that optionally turns the pages 180 degrees, so you can use the same tray for either facedown or faceup output. Fully assembled with printer, stacker, and stand, the AP 9230 weighs in at over 240 pounds, and its size jumps to roughly 40 by 56 by 26 inches.

As you might expect from the AP 9230's size and high duty cycle, installation and maintenance are similar to the in-

stallation and maintenance of a similar-size office copier. The printer is normally installed by a customer service engineer and is maintained by way of a \$575 monthly service contract. The contract does not include consumables, but encompasses regular maintenance every 60,000 copies. Unisys estimates overall cost per copy to be between 3 and 4 cents per page.

You probably expect great speed from a printer this large, and you're right—the NEC LC 3300 engine is rated at 29 pages per minute. But that assumes you don't count the startup time in getting the first page printed. On PC Labs test speed tests, the measured speeds were in the 20-ppm range, with a low of 18.7 ppm and a high of 22.2 ppm. More precisely, the speeds fall into two tightly bunched groups, depending on the orientation of the paper.

In laser printers, orientation usually refers to portrait or landscape printing. Besides printing both in portrait and in landscape mode, the AP 9230 can feed paper either longitudinally or latitudinally; it can print in both modes no matter what the orientation of the paper.

Although the AP 9230 has room for only two paper trays, it comes standard with three 250-page letter-size trays. One uses a vertical, or portrait, orientation; it feeds the paper narrow-edge first. The other two use a horizontal, or landscape, orientation; they feed the wide edge first. Unisys recommends using the horizontal tray for fastest text output and the vertical tray for fastest graphics.

The PC Labs speed tests largely confirm the Unisys recommendation. With text, the AP 9230 consistently managed about 19 ppm in vertical orientation and about 22 ppm in horizontal. On the graphics tests there was a significant difference in HP LaserJet Plus emulation: almost 90 seconds for horizontal orientation compared with about 32 seconds for vertical. However, the speed difference was almost nonexistent otherwise: about 23 seconds in either case for Epson FX emulation and about 15 seconds in either case for IBM Proprinter emulation. In short, you'll want to use the vertical orientation for HP LaserJet graphics, but you can safely ignore the paper orientation otherwise.

One other paper-handling feature worth noting is that the AP 9230 handles very large paper—up to 11 by 17 inches, either through its manual feed or through optional ledger-size trays. Unisys does not rec-

ommend using the printer for envelopes.

Aside from its speed, size, and paper handling, the AP 9230 is a typical laser printer. Print quality is a match for the LaserJet Series II, with crisp text characters, solid dark areas in graphics, and good shading and detail in the scanned photo. The front-panel controls and two-line LCD readout are like those on most other laser printers, with most menu choices in plain English. The 31 built-in fonts are a useful bonus. And for those who are interested in making use of it, the printer includes the Express programming language from Of-



**PC FACT FILE**

Unisys Corp., Box 500, Bluebell, PA 19424, (215) 542-2240.  
**List Price:** \$19,500.  
**Dimensions (HWD):** 39.5 x 55.5 x 25.5 in.  
**Weight:** 241.7 lbs  
**Emulations:** Diablo 630, Epson FX, HP LaserJet Plus, IBM Proprinter  
**In Short:** The AP 9230 is ready for the biggest office jobs you can throw at it and has a big price tag to match. It has a problem with downloadable fonts, but Unisys is working on that. If you need to process great bulk at great speed, take a look.

**CIRCLE 425 ON READER SERVICE CARD**

face Automation Systems.

On PC Labs emulation tests, the printer performed largely as expected, though it stumbled on downloadable fonts. A Unisys representative says the company is currently working on fixing the problem.

Obviously, the AP 9230 is a heavy-duty printer at a heavy-duty price. The problem with downloadable fonts is troublesome, but not necessarily enough to rule out the printer. The key issue here is quantity. Specifically, does your office generate tens of thousands of pages per month? If the answer is yes, then you might want to pencil \$19,500 into your budget and seriously consider hanging this printer on your network.

### Unisys AP 9230

## Fonts & Features

#### HP LaserJet Plus

Helvetica Times Courier Line printer

	Basic	Sub Super Underline	Basic	Sub Super Underline	Basic	Sub Super Underline	Basic	Sub Super Underline
8.9-point								
10-point								
12-point								
14-point								
Scalable								

#### IBM Proprinter XL

	Basic	Sub Super Underline	Basic	Sub Super Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

The Unisys AP 9230 can apply 21 different attributes to 22 different typefaces in portrait or landscape.

# How to get a handle on letter quality printing.



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There are a lot of reasons other than portability to get the ExpressWriter 311.

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**CIRCLE 162 ON READER SERVICE CARD**

## Unisys AP 9415

by Alfred Poir

The Unisys AP 9415 printer looks identical to several other printers in this section: same engine, same genuine PostScript, same fonts, same blazing rated speed of 15 pages per minute. Even the list price of \$7,495 is close to these other near-twins. Why pick this one?

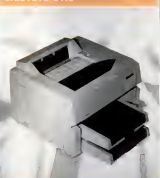
One reason might be the Ricoh 4150 engine on which it is built. The 15 ppm rating turned in test times of 8.9 ppm and 12.4 ppm under PostScript and LaserJet emulations. The differences arise largely because processing time under PostScript took just long enough for some pages to have to wait for a full drum revolution before starting to print. This engine also comes with two 250-sheet bins for paper.

The print image is excellent, with sharp edges and even toner coverage for black images. The PostScript is Version 4.0 and is pure Adobe. It comes complete with the standard complement of 35 PostScript outlines.

So what's different?

The main answer is the controller. In addition to the LaserJet emulation already mentioned, the controller can interpret commands intended for other machines:

UNISYS AP 9415



### FACT FILE

Unisys Corp., Box 500, Bluebell, PA 19424, (215) 542-2240.

List Price: \$7,495

Dimensions (HWD): 16.75 x 21.25 x 26 in

Weight: 66 lbs.

Emulations: Diablo 630, HPGL, HP LaserJet Plus, PostScript, TI-855

In Short: Aside from some drawbacks inherent in the print engine and a slightly strange selection of emulations, the AP 9415 represents a good value for a fast PostScript printer.

CIRCLE 428 ON READER SERVICE CARD

### Unisys AP 9415

## Fonts & Features

#### PostScript

	Helvetica	Times	Courier	Line printer
8.9-point	Bold	Italic	Sub-Super	Underline
10-point	Bold	Italic	Sub-Super	Underline
12-point	Bold	Italic	Sub-Super	Underline
14-point	Bold	Italic	Sub-Super	Underline
Scalable	Bold	Italic	Sub-Super	Underline

#### HP LaserJet Plus

	Helvetica	Times	Courier	Line printer
8.9-point	Bold	Italic	Sub-Super	Underline
10-point	Bold	Italic	Sub-Super	Underline
12-point	Bold	Italic	Sub-Super	Underline
14-point	Bold	Italic	Sub-Super	Underline
Scalable	Bold	Italic	Sub-Super	Underline

In addition to Adobe PostScript, the Unisys AP 9415 offers other emulations, such as HPGL.

Diablo 630, HPGL plotters, and TI-855. You can also get your input from a variety of sources: parallel, serial, and AppleTalk/RS-422 connections. The serial port can be set to communicate at speeds up to 57.6 kilobits per second.

The LaserJet emulation is excellent. The AP 9415 not only easily passed the PCL torture test but also provided access to the scalable PostScript fonts. The only minor differences are that the printable area is larger (so the left margin is smaller) and there is no Line Printer font (a small Courier font is used instead).

All is not perfect, however. There are some aspects of the Ricoh 4150 engine that are less than ideal. For example, the toner and drum are mounted in a drawer that can be yanked free from the printer inadvertently. The drum can be damaged while you install it, so you must handle it very carefully. And the toner comes in small boxes that are installed upside down over a bin; no matter how carefully I tried, I could not avoid spilling at least a small amount of toner. While there is plenty of paper capacity between the two bins, paper handling is

limited by the lack of a manual sheet feed, a way to feed envelopes, and a faceup, straight-through paper path for heavier paper stock.

The emulations themselves are not problematic, but they show signs of a slightly quirky design. It's true that the PostScript controller and the LaserJet emulation make plenty of sense and are clearly useful. The plotter emulation can also be handy, but the Diablo daisy wheel mode is simply archaic. And what is the point of including a TI-855 dot matrix emulation instead of the more common Epson or IBM Proprinter?

In the end, the AP 9415 costs a bit less than two entry-level PostScript printers; it prints about twice as fast and has more features. As long as you can live with the limitations of the engine and can use the extra speed and emulations, then the AP 9415 represents a good value worth consideration.

## Varityper VT600P

by Mary Kathleen Flynn

We've waited 2 years to take a second look at Varityper's 600-dot-per-inch PostScript printer, and it was worth the wait. When contributing editor Charles Petzold reviewed the \$18,750 Varityper VT600 for the 1987 printer issue, he found output to write home about, but he also encountered

●

**We've waited 2  
years to take a second look  
at Varityper's 600-dpi  
PostScript printer, and  
it was worth the wait.**

●

a host of hassles—such as proprietary fonts—that made it virtually inaccessible to most PC users. Since then, Varityper has brought its price down a little, fixed some of the problems, and brought out two new models: the \$16,995 VT600P and the \$22,995 VT600W (not reviewed here), which handles 11- by 17-inch paper.

# Introducing the first laser printer to let you do all this right out of the box.

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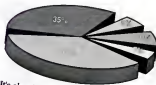
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## LASER BEAM PRINTERS



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AAAAAAAAAAAAA

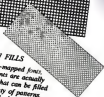
### VECTOR GRAPHICS

An enhanced vector graphic command set eliminates the jagged edges on large type and graphics you find with ordinary laser printers.



### PATTERN FILLS

Unlike bit-mapped fonts, scalable fonts are actually "outlines" that can be filled with a variety of patterns, printed in shadow and various other graphic effects.



128 FONTS  
128 FONTS  
128 FONTS  
128 FONTS  
128 FONTS

### 128 FONTS \*

A wide range of additional fonts is available on easy-to-install IC cards, including: *Arms Garde, Bookman, Elph Chancery, Century Schoolbook* and more. 128 fonts in all.

\* 128 per page

**Canon** LBP-8<sup>mark III</sup> Series  
LASER BEAM PRINTER

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## EDITOR'S CHOICE

- Brother HL-8e
- Brother HL-8PS
- Hewlett-Packard LaserJet Series IID
- Hewlett-Packard LaserJet Series IIP
- IBM LaserPrinter
- QMS PS-2200 Model S
- Varityper VT600P

As the laser printer market continues to segment itself, *PC Magazine's* Editor's Choices reflect a variety of alternatives. In addition to the mainstream laser printers like the HP LaserJet Series II, with list prices between \$1,500 and \$3,000 and street prices \$1,000 less, we see these markets within the laser market: personal laser printers (between \$1,500 and \$2,000 list); PostScript and other scalable-font printers (\$3,000 to \$13,000); high-speed, high-duty-cycle lasers (12 ppm and more, at \$10,000 to \$20,000) and lasers with such features as higher resolution, duplex printing, 11- by 17-inch paper handling, or huge paper trays (up to \$20,000). Our choices reflect these segments.

In deciding, we expect non-PostScript printers to emulate the HP LaserJet II. Products that stop with LaserJet Plus emulation, no matter how good, are out of touch with the marketplace—and out of the running for Editor's Choice.

When it comes to lasers, the low end keeps getting lower. With a list price of \$1,495, Hewlett-Packard's latest, the LaserJet Series IIP, brings a new price point to LaserJet II—quality output. At 3.9 ppm on our tests and a probable street price of \$1,000, the IIP also sets a new entry-level speed for lasers. The IIP adds a few fonts and features to the LaserJet II selection: a 12-character-per-inch Courier, italics in both 10- and 12-cpi Courier, and the ability to rotate all fonts. It even sports an easier-to-use front panel than any of its siblings. It accepts one font cartridge in a side slot, and it comes with 512K memory for graphics and downloaded fonts. Two memory slots take either 1MB

or 2MB upgrade cards for a maximum configuration of 4.5MB.

The IIP is the ideal replacement for an aging daisy wheel; it's a better alternative to many dot matrix printers; and it all but kills off the \$1,000 ink jet printer, such as HP's own DeskJet Plus. In its base configuration with 512K RAM and the ability to feed 50 sheets, the IIP is limited. To bring the street price under \$1,000, HP provides what car dealers might call a lowball price. With the \$195 optional bottom paper tray that most users will consider mandatory, the expected street price rises to about \$1,200. Fortunately, more slow-speed low-priced lasers are on the way. Okidata's 4-ppm OkiLaser 400—priced between \$1,600 and \$1,800—and Toshiba's \$1,899 6-ppm Toshiba PageLaser6 didn't make it here in time for the roundup, but both look promising.

In the 8-ppm category, the Hewlett-Packard LaserJet Series II, which won Editor's Choice in 1987, is still the standard laser printer. And with a current price of \$2,695, it's still a good bargain, a safe bet, the machine to beat, and quite possibly the one to buy. Since its cheaper sibling provides more fonts and rotates them, expect to see a Series II upgrade or replacement in the coming months.

If you need more paper capacity or multiple paper types, buy the LaserJet Series IID, which costs \$1,600 more than the II. Among its bonuses are dual paper bins, plus the ability to print on both sides of a page (with the result that you won't have to replace the paper as frequently), and additional fonts: 12-cpi Courier, Times Roman, and Helvetica Bold. As you add memory and fonts (for instance, with the soon-to-be-available \$995 PostScript cartridge), the IID becomes a better bargain.

Just in time for this roundup, Big Blue jumped into the LaserJet II-compatible market to deliver the IBM LaserPrinter, which is the best LaserJet II-class machine we've

seen. For the price of the LaserJet II, the IBM LaserPrinter gives you equivalent-quality output at a faster 8.9 ppm. You also get better paper handling, and the IBM LaserPrinter uses about 40 percent less desktop real estate than the LaserJet II. And, by next year's second quarter, PostScript options—a 13-font card for \$1,099 and a 35-font card for \$1,999—will be available. The IBM LaserPrinter even beats the LaserJet II, at least until the latter machine gets updated, with the fonts and features of its more and less expensive siblings.

Brother brought out two winners this year: the HL-8e and the HL-8PS. An upgrade of last year's Editor's Choice (the Brother HL-8), the HL-8e has updated its LaserJet compatibility; now it emulates the current-generation LaserJet II. For a list price \$200 higher than the LaserJet II, the HL-8e gives you everything the LaserJet II offers, plus more fonts: 12- and 15-point Courier-like fonts, 10- and 12.5-point Times Roman-like fonts, and a 10-point Helvetica-like font. The HL-8e also adds Diablo, Epson, and IBM PPrinter emulations.

At \$4,495, the Brother HL-8PS gives you both PostScript and LaserJet II emulations at a tested speed of 7.4 ppm. Using Brother's own PostScript emulator, the HL-8PS lets you use PostScript-clone fonts, and scale them, in LaserJet II mode. The only drawback is the lack of some foreign-language characters, which you can buy in font cartridges starting at \$250.

For a true Adobe PostScript printer priced under \$10,000, Apple's LaserWriter II models, which won Editor's Choice status last year, still can't be beat. Both the \$4,999 LaserWriter IINT and the \$6,999 LaserWriter IINTX offer high-quality output at a speed approaching 7 ppm. But if you're price-conscious, or if you already own a LaserJet II, you can get a PostScript add-in board or a software interpreter (see the sidebar

## "How to Get the Most Out of Your Laser Printer")

The Varityper VT600P generates the best output we've seen on a PC printer. At \$16,995, it's pricey, but as final page proofs, its 600-dpi output can't be beat. Besides an improved engine, what makes it so much better than the hassle-laden VT-600 we reviewed 2 years ago is a flawless Apple LaserWriter emulation and increased driver support. Now PC users can take advantage of the Varityper's spectacular output.

The winner among high-speed lasers is the QMS PS-2200 Model S. It cranked out 13.5 ppm on the PC Labs tests, making it the fastest PostScript machine in this roundup. At \$12,995, the QMS PS-2200 is expensive, but it has a lot of power: Adobe PostScript, a recommended duty cycle of 20,000 copies per month, support for 11- by 17-inch paper, and two 250-sheet paper trays. For lots of PostScript output fast, the QMS PS-2200 is your best choice.

Other high-speed lasers deserve honorable mention for their speeds but lose points for not offering the current-generation LaserJet II emulation: the \$9,350 Fujitsu RX7300E, which scored 14.8 ppm; the \$15,500 Printronix L2324 Report Expediter, which came in at 20.9 ppm; and the \$19,500 Unisys AP 9230, which, at 21.5 ppm, is the fastest printer in this year's crowd.

An honorable mention also goes to the \$2,995 Canon LPB-8 Mark III, which comes with everything we're waiting for in the next generation of HP printers (see the sidebar "Printer Languages: The Next Generation"): nine scalable fonts, a graphics language, and 1.5MB base memory. For \$295 more, you can complete the font set to get virtually all the fonts you'll find in PostScript. The Canon LPB-8 Mark III misses the mark by offering only a Diablo emulation, although it does seem to have healthy driver support, and a forthcoming optional Adobe PostScript cartridge is promised.

What's new in the VT600P is an Apple LaserWriter PostScript emulation that lets you use the printer with PC software; driver support from popular PC applications, such as *Microsoft Windows*; full-page buffering; and a new 10-page-per-minute Varityper laser engine that can handle smaller-particle toner.

The new toner is significant. The VT600P is the only 600-dpi printer in this roundup because getting the toner granularity fine enough to make 600 dpi effective in laser printing technology is a difficult task.

Most high-resolution printers use 14-micron toner. The 10-ppm Varityper engine uses 8-micron toner, which lets it produce 600-dpi output that looked truly outstanding on our scanned photo test.

**The Varityper VT600P is designed for applications that demand camera-ready masters but don't need typeset-caliber 1,200 dpi. Newspapers offer a good example.**

The VT600P is designed for applications that demand camera-ready masters but don't need typeset-caliber 1,200 dpi. Newspapers offer a good example—and a solid customer base for Varityper. And, in fact, the output from our halftone test looks a lot like a newspaper photo. When you're printing on paper that's as lousy as newspaper stock, you really can't see the difference between 600 and 1,200 dpi. And, when you're making final page proofs—which are used for proofing, not filming—600 dpi is a luxury users may decide they can afford.

But before you decide to buy, make sure you take a look at the high costs of owning the VT600P. At \$16,995 (with a street price between \$15,000 and \$16,000)

## Varityper VT600P

### Fonts & Features

	PostScript				Times				Courier				Line printer			
	Helvetica	Times	Courier	Line printer	Helvetica	Times	Courier	Line printer	Helvetica	Times	Courier	Line printer	Helvetica	Times	Courier	Line printer
8-9-point	Bold	Italic	Sub-Super	Underline	Bold	Italic	Sub-Super	Underline	Bold	Italic	Sub-Super	Underline	Bold	Italic	Sub-Super	Underline
10-point																
12-point																
14-point																
Scalable																

The VT600P uses Adobe PostScript and offers Courier, Helvetica, and Times in LaserWriter emulation.

this printer will cost you about as much as the most expensive 300-dpi color PostScript page printer reviewed in this issue. Indeed, Varityper is exploring the possibilities of color. The printer's buffering system, which has the potential to store several passes, may be used for color applications someday.

The printer's price tag isn't the only cost to consider. A 176-pound giant, the VT600P is also a delicate machine that must be installed by a field engineer and should be maintained with a service contract, which will cost you \$2,195 for the VT600P (\$2,595 for the VT600W). The contract includes all parts and labor, except for the \$750 drum, which should be replaced every 24,000 prints.

Although the duty cycle that Varityper quotes is 3,000 prints per month, if you exceed 15,000 prints annually, you'll be charged an extra \$.09 per page in service. However, all but the most heavy-volume users will be satisfied with 15,000 prints per year. Nonetheless, an upgrade, due by year's end, will escalate the duty cycle to 20,000 pages per month.

Add to the price of the printer and service contract the \$.05 per-page printing cost (excluding paper) and the \$18 toner bottle, which should be replaced every 2,000 copies, and this printer will take a big bite out of your budget.

The good news is you'll get your money's worth. Unlike the VT600 printer that we reviewed 2 years ago, the VT600P sailed through our PC Labs tests under the LaserWriter emulation and a Varityper driver. It handled our text speed test at 7.9 ppm—a respectable score for a PostScript printer. It printed the halftone image



PRINTERS  
LASER PRINTERS

beautifully in a reasonable 2 minutes 3 seconds.

We tested the VT600P with a Centronics connector, but you can also use RS-232 and SCSI connectors. The PC Labs PostScript status page revealed that the Varityper uses Adobe PostScript, Version 48.0. Under the LaserWriter emulation, Courier, Helvetica, Symbol, and Times were resident with enhancements. Varityper also sells downloadable fonts at \$195

for a family of four typefaces. A 200-sheet bin comes standard, and an optional legal-size bin is \$139.

The unit we tested came with a 20MB hard disk—now less rare than it was 2 years ago—and 6MB of base memory. By the time you read this, Varityper should be shipping a 42MB optional hard disk.

For PC users, the VT600P still brings

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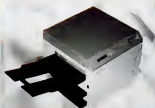
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### VARITYPER VT600P



#### FACT FILE

#### EDITOR'S CHOICE

Varityper Inc., 11 Mt. Pleasant Ave., East Hanover, NJ 07936; (800) 631-8134, (201) 887-8000.

List Price: \$16,995

Dimensions (HWD): 19 x 39 x 21 in.

Weight: 176 lbs

Emulations: PostScript

In Short: The VT600P addresses many of the problems we encountered 2 years ago with the earlier VT600. Under the Apple LaserWriter emulation, it printed crisp text in Courier, Helvetica, Symbol, and Times. The only 600-dpi printer reviewed here, the VT600P produced spectacular graphics output.

CIRCLE 542 ON READER SERVICE CARD

some annoyances, such as its Macintosh focus: a thorough PC user manual still hadn't been printed at press time, though a spokesperson said that one was in the works. And the VT600P's LED front pan-

For splendid output  
that won't keep you  
waiting, the VT600P  
is worth its weight  
in printers.

el proves that even icons can be unintuitive.

But if you want splendid 600-dpi PostScript output that won't keep you waiting all day, the Varityper VT600P is worth its weight in printers. And if you need final page proofs or can give up 1,200 dpi for your camera-ready output, the VT600P even justifies its steep price.

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*-Personal Computing's 10 Best Mail Order Companies, Feb, 1989*



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**PCV20 AD-II \$539**

15 MHz Throughput in an XT. Norton SI 4.0  
 512K, 360K Drive, 84-Key Keyboard

### Standard System Features:

- 10MHz Nec V20 CPU with 1.5 times the power of the 8088
- 512K RAM standard. Expandable to 640KB
- One 360K Floppy Drive • 84-key AT Style Keyboard
- 8 Slots. Serial, Parallel, Game Ports, and Clock Standard
- AT Style Case with Keylock, Turbo, Power and Hard Drive LEDs.  
 Accommodates up to 4 HH Mass Storage devices
- Set-up & Operating instructions.

### Standard Pre-Built Configurations:

PCV20 AD-II With 512K, Hard Disk Drive, Monitor & Video Card				
Drive Video	1 Floppy	2 Floppy	40MB-45MS 1.1 RLL	66MB-25MS 1.1 RLL
Mono	\$664	\$739	\$944	\$1094
VGA/Mono	\$824	\$899	\$1104	\$1254
EGA	\$1004	\$1079	\$1284	\$1434
VGA/Color	\$1054	\$1129	\$1334	\$1484

**PC BRAND 286/12 \$799**



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12 MHz Clock, Zero Wait Operation,  
 Norton SI 15.3 • Landmark™ Speed 15.1MHz  
 512K, 1.2MB or 1.44MB Drive, 101- Keyboard

### Standard System Features:

- 80286-12 Processor Operating at 12MHz with Zero Wait States delivering 15.1MHz Effective Throughput
- 512K RAM expandable to 4MB on the System board using 256K or 1MB 100ns RAM
- 1.2MB 5.25" or 1.44MB 3.5" Diskette Drive
- 1:1 Interleaving Dual Hard Drive/Floppy Drive Controller
- Enhanced 101-key AT Style Keyboard
- High Capacity System Power supply
- Real Time Clock/Calendar with 5 Year Battery
- 80287 Co-Processor Support
- AMI BIOS with full MS/DOCS, OS/2, XENDX, UNIX, NOVELL, 3COM and PCNET compatibility
- Built-in System Board LIM 4.0 EMS hardware drivers
- User configurable I/O timing permitting compatible operation with older peripherals or faster I/O for newer devices
- 8 Slot motherboard design (5 16Bit & 3 8Bit)
- Medium foot print case with 5 Disk Drive bays

### Options:

- Factory Installed RAM Upgrades
- Custom configurations w/ Name Brand peripherals of your choice
- Compaq® Style LCD or Plasma Portable
- Mini Size Tower Case®

### Standard Pre-Built Configurations:

286/12 With 512K, Hard Disk Drive, Monitor & Video Card					
Drive Video	40MB-45MS 1.1 RLL	66MB-25MS 1.1 RLL	71MB-10MS 1.1 MPFI	110MB-25MS 1.1 RLL	110MB-25MS 1.1 RLL
Mono	\$1207	\$1432	\$1572	\$1672	\$1672
VGA/Mono	\$1402	\$1627	\$1767	\$1867	\$1867
EGA	\$1547	\$1772	\$1912	\$2012	\$2012
VGA/16Bit	\$1637	\$1862	\$2002	\$2102	\$2102

# Unbelievable Price

## PC BRAND 286/20 \$999



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20 MHz Clock, Zero Wait Operation  
Norton SI 23.0 • Landmark™ 26.7MHz  
512K, 1.2MB or 1.44MB Drive, 101-KeyBoard

### Standard System Features:

- 80286 Processor Operating at 20MHz w/Zero Wait States in interleave mode delivering 27MHz Effective Throughput
- 512K RAM expandable to 8MB on the System board using 256K and/or 1MB 100ns RAM
- 1.2MB 5.25" or 1.44MB 3.5" Diskette Drive
- 1:1 Interleaving Dual Hard Drive/Floppy Drive controller
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- Built-in System Board LIM 4.0 EMS hardware drivers
- User configurable I/O timing permitting compatible operation with older peripherals or faster I/O for newer devices
- 8 Slot motherboard design (5 16Bit & 3 8Bit)
- Medium foot print case with 5 Disk Drive bays

### Options:

- Mini Size Tower • Case • Factory Installed RAM Upgrades
- Custom configurations w/Name Brand peripherals of your choice
- Compaq® Style LCD or Plasma Portable

### Standard Pre-Built Configurations:

	286/20 w/512K, Hard Disk Drive, Monitor & Video Card					
Video	Drives	40MB-45MB 1:1 RLL	64MB-25MB 1:1 RLL	71MB-18MB 1:1 MFM	100MB-25MB 1:1 RLL	150-175MB 1:1 ESDI
Mono		\$1407	\$1632	\$1737	\$1862	\$2357
VGA/Mono		\$1602	\$1827	\$1932	\$2057	\$2552
EGA		\$1747	\$1972	\$2077	\$2202	\$2697
VGA/16Bit		\$1837	\$2062	\$2167	\$2292	\$2787

## PC BRAND 386/SX-16 \$1099



16 MHz Clock, Zero Wait Operation  
Norton SI 18.7 • Landmark™ 18.3MHz  
512K, 1.2MB or 1.44MB Drive, 101-KeyBoard

### Standard System Features:

- 80386SX Processor Operating at 16MHz delivering 18MHz Effective Throughput
- 512K RAM expandable to 8MB on the System board using 256K and/or 1MB 80ns RAM
- 1.2MB 5.25" or 1.44MB 3.5" Diskette Drive
- 1:1 Interleaving Dual Hard Drive/Floppy Drive controller
- Enhanced 101-key AT Style Keyboard
- High Capacity 200 Watt System Power Supply
- Real Time Clock/Calendar with 5 Year Battery
- 80387SX Co-Processor Support
- AMI BIOS with full MS/DOS, OS/2, XENIX, UNIX, NOVELL, 3COM, and PCNET compatibility
- 8 Slot motherboard design (5 16Bit & 3 8Bit)
- Medium foot print case with 5 Disk Drive bays (Shown with optional Mini Size Tower & Case)

### Options:

- Mini Size Tower • Case • Factory Installed RAM Upgrades
- Custom configurations w/Name Brand peripherals of your choice
- Compaq® Style LCD or Plasma Portable

### Standard Pre-Built Configurations:

	386SX-16 w/512K, Hard Disk Drive, Monitor & Video Card					
Video	Drives	40MB-45MB 1:1 RLL	64MB-25MB 1:1 RLL	71MB-18MB 1:1 MFM	100MB-25MB 1:1 RLL	150-175MB 1:1 ESDI
Mono		\$1507	\$1732	\$1837	\$1962	\$2457
VGA/Mono		\$1702	\$1927	\$2032	\$2157	\$2652
EGA		\$1847	\$2072	\$2177	\$2302	\$2797
VGA/16Bit		\$1937	\$2162	\$2267	\$2392	\$2887

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Norton SI 23.0 • Landmark Speed 26.1MHz  
1024K, 1.2MB or 1.44MB Drive, 101-Keyboard

### Standard System Features:

- True 20MHz Intel 80386-20 CPU Operating with Zero Wait States delivering up to 26.1MHz Effective Throughput
- 1024K RAM standard expandable to 16MB using 256K and/or 1MB 100ns RAM
- 1.2MB 5.25" or 1.44MB 3.5" Diskette Drive
- 1:1 Interleaving Dual Hard Drive/Floppy Drive controller, 977.6 KB/SEC Caching Controller w/ESDI Configurations
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- 8 Slot motherboard design (5 16bit & 3 8bit)
- Medium foot print case with 5 Disk Drive bays

### Options:

- Full or Mini Size Tower @ Case
- Custom configurations w/Name Brand peripherals of your choice
- Compaq® Style LCD or Plasma Portable • Weitek Co-processor

### Standard Pre-Built Configurations:

386/20 With 1024K, Hard Disk Drive, Monitor & Video Card						
Drives	40MB-45MB	40MB-25MB	75MB-18MB	100-25MB	150-17MB	320-16MB
Value	1.1 MB	1.1 MB	1.1 MB	1.1 MB	1.1 MB	1.1 MB
Mono	\$1995	\$2095	\$2220	\$2330	\$2860	\$3305
VGA/Mono	\$2170	\$2270	\$2395	\$2505	\$3035	\$3480
EGA	\$2280	\$2380	\$2505	\$2615	\$3145	\$3590
VGA/16bit	\$2370	\$2470	\$2595	\$2705	\$3235	\$3680

## PC BRAND 386/25 \$1689



25 MHz Clock, Zero Wait Operation  
Norton SI 28.2 • Landmark Speed 33.6MHz  
Norton SI 31.6 • Landmark Speed 43.5 w/Cache  
1024K, 1.2MB or 1.44MB Drive, 101-Keyboard

### Standard System Features:

- Intel 80386 Processor Operating at 25MHz with Zero Wait States in interleave mode delivering 34 to 44 MHz Effective Throughput
- 1024K RAM standard expandable to 16MB using 256K and/or 1MB RAM
- 1.2MB 5.25" or 1.44MB 3.5" Diskette Drive
- 1:1 Interleaving Dual Hard Drive/Floppy Drive controller, 977.6 KB/SEC Caching Controller w/ESDI Configurations
- Enhanced 101-key AT Style Keyboard
- High Capacity 200 Watt System Power Supply
- Real Time Clock/Calendar with 5 Year Battery
- 80287, 80387 or Weitek Co-Processor Support
- Industry Standard BIOS with full MS/DOS, OS/2, XENIX, UNIX, NOVELL, 3COM and PCNET compatibility
- User configurable I/O timing permitting compatible operation with older peripherals or faster I/O for newer devices
- 8 Slot motherboard design
- Medium foot print case with 5 Disk Drive bays (Full size case w/cache)

### Options:

- 32KB or 64KB Cache Processor • Weitek Co-processor • Tower @ Case
- Custom configurations w/Name Brand peripherals of your choice
- Compaq® Style LCD or Plasma Portable • 8MB 32bit RAM Card

### Standard Pre-Built Configurations:

386/25 With Hard Disk Drive, Monitor & Video Card						
Drives	40MB-45MB	40MB-25MB	75MB-18MB	100-25MB	150-17MB	320-16MB
Value	1.1 MB	1.1 MB	1.1 MB	1.1 MB	1.1 MB	1.1 MB
Mono	\$2182	\$2332	\$2462	\$2592	\$3162	\$3412
VGA/Mono	\$2387	\$2537	\$2667	\$2797	\$3367	\$3617
EGA	\$2502	\$2652	\$2782	\$2912	\$3482	\$3732
VGA/16bit	\$2577	\$2727	\$2857	\$2987	\$3557	\$3807

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1024K, 1.2MB or 1.44MB Drive, 101-Key Keyboard

### Standard System Features:

- True 33 MHz INTEL 80386-33 CPU operating with Zero Wait States Delivering up to 58.7 MHz Effective Throughput
- Intel 82385-33 Cache Processor with 32K 25NS Static RAM Standard, Field Upgradable to 64K
- 1024K RAM Standard Expandable to 16MB
- 1.2MB 5.25" or 1.44MB 3.5" Diskette Drive
- 1:1 Interleaving Dual Hard Drive/Floppy Drive Controller, 977.6 KB/SEC Caching Controller w/ESDI Configurations
- Enhanced 101-key AT Style Keyboard
- High Capacity 200 Watt System Power Supply
- Real Time Clock/Calendar with 5 Year Battery
- 80387 or Weitek Co-Processor support
- Phoenix BIOS With Full MS/DOS, OS/2, XENIX, UNIX, NOVELL, 3COM and PCNET compatibility
- 8 Slot motherboard design
- Full size case with 5 Disk Drive bays

(Shown with Optional Full Size Tower @ Case)

### Options:

- Custom configurations w/Name Brand peripherals of your choice
- Weitek Co-Processor • Tower • Case • Factory Ram Upgrades

### Standard Pre-Built Configurations:

386/33 With Hard Disk Drive, Monitor & Video Card						
Drives	40MB-40MB 1:1 EMD	40MB-25MB 1:1 EMD	71MB-16MB 1:1 EMD	10MB-25MB 1:1 EMD	15MB-17MB 1:1 EMD	33MB-16MB 1:1 EMD
Video						
Mono	\$3259	\$3454	\$3554	\$3679	\$4124	\$4634
VGA/Adapt	\$3454	\$3649	\$3749	\$3874	\$4319	\$4829
EGA	\$3599	\$3794	\$3894	\$4019	\$4464	\$4974
VGA/16MB	\$3689	\$3884	\$3984	\$4109	\$4554	\$5064

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- 86-key keyboard
- Accommodates two 5.25" or 3.5" Floppy/Hard Disk Drives
- 200 Watt 112/220 Autoswitch Power
- Serial, Parallel, Game Port, Clock/Calendar Standard

### Standard Pre-Built Configurations:

Portable System Processor and Drive Options					
Drive \ CPU	286-12	286-20	386/SX-16	386-20	386-25
1 Floppy	\$1745	\$1945	\$2045	\$2595	\$2795
40MB	\$2175	\$2375	\$2475	\$3025	\$3225
66MB	\$2275	\$2475	\$2575	\$3125	\$3325
150MB	\$3140	\$3340	\$3440	\$3990	\$4190

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**Howtek Pixelmaster**

\$8,485 PostScript ink jet



Text Speed BATCH MODE 0 3 6 9 12 15 ppm N/A

Graphics Speed POSTSCRIPT EMULATOR 100 min. 55 sec. 0.01 gppm



Once you've torn down all of laws in the country and you fi yourself face to face with the Devil, what will you hide beh  
Courier **Bold Underli**  
Palatino **Bold Underlined**

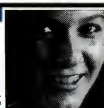
**QMS ColorScript 100 Model 10**

\$9,995 PostScript thermal transfer



Text Speed 0 3 6 9 12 15 ppm 2.8 ppm

Graphics Speed POSTSCRIPT 2 min. 33 sec. 0.4 gppm



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Courier **Bold Underli**  
Palatino **Bold Underlined**

**QMS ColorScript 100 Model 30**

\$15,995 PostScript thermal transfer; 11- x 17-inch paper



Text Speed 0 3 6 9 12 15 ppm 2.2 ppm

Graphics Speed POSTSCRIPT 14 min. 31 sec. 0.07 gppm



Once you've torn down all of laws in the country and you fi yourself face to face with the Devil, what will you hide beh  
Courier **Bold Underli**  
Palatino **Bold Underlined**

**Seiko Instruments CH-5504-PS**

\$8,245 PostScript thermal transfer



Text Speed BATCH MODE 0 3 6 9 12 15 ppm N/A

Graphics Speed POSTSCRIPT EMULATOR 9 min. 52 sec. 0.1 gppm



Once you've torn down all of laws in the country and you fi yourself face to face with the Devil, what will you hide beh  
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**Tektronix Phaser CP**

\$12,995 PostScript thermal transfer



Text Speed 0 3 6 9 12 15 ppm 1.2 ppm

Graphics Speed POSTSCRIPT EMULATOR 12 min. 16 sec. 0.08 gppm



Once you've torn down all of laws in the country and you fi yourself face to face with the Devil, what will you hide beh  
Courier **Bold Underli**  
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N/A—Not applicable: PC Labs text speed tests could not be run because the printer prints to disk and external software handles the actual printing.

# Compare Printer Sharing Devices, SL is the best.

Feature Description	Competition	SL	SL Advantage
Number of total ports	8	10	25%
Number of serial ports (input or output)	4	6	50%
Number of parallel ports	2 input, 2 output	4 input or output	up to 100%
Maximum serial data transfer speed	9,600 bps	38,400 bps	400%
Maximum buffer size available	1MB	4MB	400%
Maximum number of cascaded devices	45	Millions	Millions %
Menus pop-up over graphics/DTP	No	Yes	Convenience
Power supply	External	Internal	Reliability
Price for each unit with 256KB buffer	\$695	\$600	14% Less
Price for each unit with 512KB buffer	\$795	\$700	12% Less
Price for each unit with 1MB buffer	\$1,095	\$900	18% Less

- **38,400 bps:** transfer serial data at 4 times faster than normal serial speed—the speed of parallel with all the advantages of serial (bi-directional communication, etc.).
- **Ten channels:** four parallel and six serial, all can be software configured as either input or output.
- **Pop-up Menu:** keyboard selection of printers, macros and many other control functions.
- **Automatic Switching:** no software needed if always sending data to only one printer.
- **Interface Conversion:** automatic parallel to serial, serial to parallel, or serial to serial parameters.
- **Compatible with Minis or Mainframes:** any RS-232-C asynchronous serial or parallel connection.
- **User Upgradable Memory:** from 0 to 4MB buffer.
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## PC Magazine says...

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*by Gerard Kunkel*

In the last year, a wave of product introductions and price reductions has lifted the color page printer market out of the realm of fantasy and into the reality of corporate desktop publishing. Boardroom-quality color prints are now available from a variety of machines at reasonable prices. For the first time in the 6-year history of *PC Magazine's* printer project, we've dedicated a special section to high-end color page printers.

Don't try these at home, folks: color page printers are not geared toward the home or small-business user. These color PostScript printers—with their \$8,000 to \$16,000 price tags and high-resolution four-color output—belong in the corporate art department or professional service bureau, where users are willing to spend up to \$1.50 per print to get the high-quality output they need.

*PC Magazine* is a good case in point. Here, we produce up to 100 color proofs every two weeks. Using an in-house color printer to make these proofs costs about \$1.50 per print, compared with \$35.00 per piece with a 3M Colorkey process. A color printer lets us save about \$750,000 a year. We've also found a productivity gain: now we can see our charts, graphs, and artwork within minutes, allowing us to correct errors well before the film stage. It hasn't taken long for us to believe that the design phase of any project is enhanced when dazzling color comps come directly from your computer.

#### MELTING MEDIA

Although these printers are commonly referred to as color laser printers, not one of these devices actually uses laser technology. Instead they rely on various thermal transfer technologies; the color transfer material is either wax or a plastic polymer. These devices all rely on heat to create a phase change at the time of impression. More descriptively, the wax or plastic is stored as a solid. Heat is applied to it so that it melts and sticks to the paper. The medium then dries as a solid on the paper.

Some color print materials offer advantages over others. For instance, the plastic material used by the Howtek Pixelmaster (reviewed here) is extremely durable. You could drive a truck across its printouts and not lift plastic from paper. The cost of these prints, about \$.05 to \$.10 a copy, is a great advantage. The downside is that these plastic prints betray a texture.

The Tektronix Phaser CP, on the other hand, uses a wax-transfer process that pro-

duces some of the brightest color prints you could ever hope for. However, the wax medium is delicate, and printouts can easily be marred under normal business abuse, such as rubbing against paper clips, pencils, and so forth.

#### FULL PALETTE

All the color page printers reviewed here produce superb output. And all use PostScript, although QMS's printers are the only ones that come with Adobe PostScript on-board. How much you'll have to pay for these high-end printers varies. If price is a concern, make sure you consider cost per print, as well as the price of the printer. Other features to consider are monthly duty cycle (although some vendors declined to quantify a duty cycle), the ability to print on the larger B-size paper, and speed—though not one of these printers is particularly fast.

Better quality and lower prices loom on the horizon for color page printers. QMS recently introduced the \$10,000 ColorScript 100 Model 10 (reviewed here) and slashed the price of its Model 30 (also included here) to \$15,995. Both CalComp and NEC were readying PostScript printers priced under \$10,000 as we went to press. Although printer prices are dropping, the specialized paper, which is an integral part of this print process, is not likely to come down in price any time soon. And as for quality? The output speaks for itself: it can't get much better than this. Or can it?

## Howtek Pixelmaster

by Alfred Poor

You might have thought you left colored crayons behind in kindergarten, but you may be tempted to use them again. You may even be persuaded to spend the \$8,495 list price for a Howtek Pixelmaster ink jet printer just to watch it draw with crayons.

Sound crazy? The Pixelmaster is an ink jet printer that uses melted plastic as ink, and it's the least-expensive color page printer in this roundup. The small plastic crayons come in the four basic pigments: black, cyan, magenta, and yellow. By mixing these four pigments, the printer can produce almost any color you wish.

The Pixelmaster looks unusual: in a different setting, it could easily be mistaken for an apartment-size washing machine. It

### Howtek Pixelmaster Fonts & Features

	Helvetica	Times	Courier	Line printer
	Bold Italic Sub Super Underline	Bold Italic Sub Super Underline	Bold Italic Sub Super Underline	Bold Italic Sub Super Underline
6.9-point				
10-point				
12-point				
14-point				
Scalable				

	Helvetica	Times	Courier	Line printer
	Bold Italic Sub Super Underline	Bold Italic Sub Super Underline	Bold Italic Sub Super Underline	Bold Italic Sub Super Underline
6.9-point				
10-point				
12-point				
14-point				
Scalable				

The Howtek Pixelmaster is a PostScript emulator. ScriptPlus runs on OS/2 with over 35 standard fonts.

is about 15 inches square and stands more than 3 feet high. Paper feeds from a tray at the bottom, stuck sideways into the base on the right side. The print head (eight nozzles for each color) is in the back of the machine, and paper then makes a U-turn at the top of the case and drops into a bin that is open to the front.

There is a hatch at the top that you can open in order to clear paper jams and load the ink crayons. The Pixelmaster could be nicknamed the "Fisher-Price Machine" for its very clever crayon-loading scheme. The holes are color-coded to show which one goes where. But just to make sure you don't make a mistake (or if you are color blind), each crayon has a unique shape that matches the correct hole: black crayons are round, magenta are hexagonal, and so forth. The crayon approach is also inexpensive; Howtek estimates a per-page cost of between 5 and 10 cents (excluding paper)—about one tenth that of competing color printers.

Since the ink is melted plastic, it actually sits on top of the page rather than sinking into the fibers as a liquid ink does. The result is that you get a raised image, much like the raised lettering on a business card printed with thermographic ink. While I was testing this machine in the Labs, one

# HOWTEK PIXELMASTER



## FACT FILE

Howtek Inc., 21 Park Ave., Hudson, NH 03051;  
(603) 882-5200.  
List Price: \$8,495  
Dimensions (HWD): 36.5 x 15 x 16 in  
Weight: 65 lbs.  
Emulations: PostScript emulation (in batch mode only) on disk, HP LaserJet Series II, HPGL II, Short. With a list price well below the \$10,000 mark and a low per-page cost, the Pixelmaster is a surprising bargain that produces vibrant color output—at 240-dpi resolution. Its major liabilities are slow speed and batch-only PostScript file processing, but many users will find these acceptable given the other attractions.

CIRCLE 544 ON READER SERVICE CARD

program allows you to send PostScript files in a batch mode to the Pixelmaster for 240-dpi output in full color. In spite of the lower resolution compared with some of the other color page printers, the Pixelmaster managed to produce some of the sharpest images, with vivid, fully saturated colors. Although the colors are attractive, they aren't true hues, and the output shows banding.

It is fortunate that the Pixelmaster excels in color output because it is rather weak in other areas, not the least of which is its text output speed. It is rated at 0.3 to 0.5 ppm, and while these turn out to be conservative estimates, the 0.6-ppm draft and 0.4-ppm final quality speeds are not going to be useful for 100-page documents. Like all the color page printers in this roundup, the Pixelmaster is better suited for single pages of artwork, such as graphs, report covers, and illustrations. At 240 dpi, the Pixelmaster completed the graphics test in almost 11 minutes, a bit faster than most of the color page printers tested here.

The printer has some quirky features. For example, when you select draft mode, the word *Draft* is printed in large letters across the page. The character print quality is so bad that you probably wouldn't want to hand out a copy of the page to anyone, but the word *Draft* at the top of the page will eliminate all temptation. On the other hand, there are useful features, such as a label pasted inside the top hatch that shows all the setup commands for the front panel.

The Pixelmaster is a serious competitor for low-cost color PostScript output. The list price of under \$10,000 and low per-page cost make its vivid output even more alluring. These strong points are balanced by its slow text speed, lower resolution, and batch-mode processing of PostScript files. But if you can live with those limitations, the Pixelmaster could well be a good choice for color output.

## QMS ColorScript 100 Model 10

by M. David Stone

For \$6,000 less than the QMS ColorScript 100 Model 30 (also reviewed here), the newer, smaller Model 10 gives you the same Adobe PostScript and 300-dot-per-

inch resolution, with the same exquisite detail and vibrant color. All you have to give up is the Model 30's larger page size and heavier duty cycle. The Model 10's \$9,995 price tag may not be bargain basement, but it's certainly in the realm of the affordable.

The Model 10 uses the same technology as the Model 30, but in a smaller engine. Built around the Mitsubishi G370, the printer measures about 25 inches deep by 17 inches wide by 11 inches high, making it a comfortable size for a desktop. The smaller engine is responsible for the price difference between the printers, and for the only important differences in functionality: paper size and recommended maximum copies per month.

The Model 10 is limited to a maximum size of 8.5- by 14-inch paper. This is more than enough for boardroom-level graphics and even many publishing tasks, but it's

## QMS ColorScript 100 Model 10 Fonts & Features

	Helvetica	Times	Courier	Line printer
	Bold B&S Super Underline	Bold B&S Super Underline	Bold B&S Super Underline	Bold B&S Super Underline
8.9-point				
10-point				
12-point				
14-point				
Scaleable				

Also QMS ColorScript Model 16 comes with 39 resident Adobe fonts and an optional HPGL emulation for \$199.

not large enough for graphic artists who need to see two pages at once. For larger-format output, you need the Model 30, with its maximum paper size of 11 by 17 inches.

The second limitation is less severe—at least in the sense that if your budget constraints are enough to limit you to the Model 10, then you probably don't need the heavy-duty 4,000-page-per-month capability of the Model 30. The recommended maximum monthly output for the Model 10 is 1,200 pages.

Other differences are minor. For example, the smaller engine doesn't have room for an ink sheet roll with as large a diameter, so you get fewer prints per roll. This difference adds up to slightly more money

onlooker suggested that it might be a good way to produce short runs of invitations. And since the ink is sprayed onto the paper, you can use plain paper. You should plan on using high-quality paper, however, because some of the tests we ran with fairly cheap copier paper resulted in more than a few jams.

Howtek quantifies Pixelmaster's durability using a measure other than duty cycle. According to Howtek, the mean time between failures is 2,000 power-on hours.

The printer comes with a built-in LaserJet Series II emulation, plus an extended command set that gives you access to the four ink colors. The 240-dot-per-inch Pixelmaster has a special emulation mode that adjusts for the 300-dpi resolution of the HP LaserJet. Unfortunately, this LaserJet mode has some flaws; it failed to perform the font download and macro portions of the PC Labs PCL torture test page.

More useful than the LaserJet mode, however, is the PostScript emulation program, *Script-It*, that comes on-disk. This



**QMS COLORSCRIPT 100  
MODEL 10**



**PC FACT FILE  
EDITOR'S CHOICE**

QMS Inc., One Magnum Pass, Mobile, AL 36618, (800) 631-2692 ext. 902, (205) 633-4300.  
List Price: \$9,995  
Dimensions (HWD): 11 x 16.9 x 24.6 in.  
Weight: 65 lbs  
Emulations: PostScript, HPGL on-disk, \$199  
In Short: The ColorScript 100 Model 10 brings color thermal technology into the realm of the affordable. Even better, its brilliant colors, sharp detail, and speed are an easy match for printers that cost a lot more. And it offers on-board Adobe PostScript and 300-dpi resolution. Its one limitation is page size, with a maximum of 8.5 by 14 inches. Unless you need larger paper, there is no reason to pay more.

CIRCLE 545 ON READER SERVICE CARD

per page than with the Model 30.

Similarly, the smaller printer doesn't have room for a built-in disk drive for additional fonts. However, QMS will sell you an external 20MB SCSI disk for \$995 or a 40MB disk for \$1,495. Not so incidentally, the Model 10 comes with the 35 standard PostScript fonts built in, plus four Helvetica Narrow fonts on-disk.

As with the Model 30, you have a choice of three ink-sheet types: all-black, three-color, or four-color. For color printing, the four-color sheet is generally the best choice since it gives a more solid black than you get by mixing the colors of the three-color ribbon. For black-and-white printing, the all-black sheet is the preferred choice; it will let you print without skipping over the colors and thereby wasting three-fourths of the ink sheet.

The number of prints per ink sheet varies. For 8.5-by-11-inch prints, you can get 300 prints from the all-black sheet, 100 from the three-color sheet, or 85 from the four-color sheet. For letter-size paper, the

cost per print varies from 18 cents per page for the black-only sheet to 53 cents per page for the four-color sheet. Add 6 cents per print for the special thermal paper.

At this price per page, you'll generally want to reserve the printer for color. However, as with the Model 30, there are two reasons for using black-and-white output. First, if you're preparing camera-ready art to send to a printer, you'll want the sharpest output you can get—even for text and black-and-white graphics. You'll probably want to run your test pages on some other PostScript printer, but for final art, the Model 10's output can't be beat.

The black-and-white output is also important for color printing. Professional four-color printing starts with four monochrome plates called separations. Each plate serves as a template for printing a single color on the page. With the Model 10, as with the Model 30, you can print separations for any color image. The Model 10 introduces a convenient feature: simply flip the Separation switch on the back of the unit and print your color image as usual. The Model 10 will print it as four black-and-white separations.

As you might expect, text speed is not one of the strong points for this printer. Overall, the Model 10 scored roughly the same as or a little faster than the Model 30 on our text speed tests. With the four-color ribbon, the Model 10 scored a leisurely 1.1 pages per minute on the text speed test. With the all-black ink sheet it did somewhat better at 2.8 ppm. The difference in speed comes from the need to scroll the color ink sheet past the extra three colors to reach the next black section. Only then can the Model 10 print the next page.

Graphics speed is much better. In fact, the measured 153 seconds makes the Model 10 by far the fastest color page printer reviewed here—and makes it almost as fast for graphics as many monochrome PostScript printers.

The output is beyond reproach, with exquisite detail and brilliant colors. The manual is also worth special note. In particular the section on professional color printing offers a readable and highly informative discussion on color theory, color separation, and other considerations for color printing. As with the Model 30, the printer comes with parallel, serial, and AppleTalk connectors. Unlike the Model 30, the Model 10 printer comes without the HPGL emulation utility, but the pack-

age is available as a \$199 option.

With the Model 10, QMS has truly made thermal color technology accessible. Compared with slightly less expensive color page printers from other vendors, the Model 10's advantages are on-board Adobe PostScript, faster speeds in graphics and text, and higher resolution. Graphic artists who need large-format printing will still want QMS's Model 30, but if you don't need the large page size and you don't need the 4,000-page-per-month capability, there's no reason to pay the extra \$6,000 for the Model 30.

## QMS ColorScript 100 Model 30

by Alfred Poor

When QMS introduced its ColorScript 100 Model 30 last year, it was the only color PostScript printer on the market. Since then, several competitors have brought out color PostScript printers, and QMS has slashed the price of its Model 30—twice. If the Model 30's current price of \$15,995 still sounds like a lot to pay for a PC page printer, consider that it cost \$10,000 more a year ago.

An even more aggressive move QMS made this year was to introduce the \$9,995 ColorScript 100 Model 10 (also reviewed here), the least expensive printer with on-board color PostScript in this roundup. Both QMS models make gorgeous full-color prints at 300 dots per inch. So why pay the additional \$6,000 for the Model 30? Because it's the only color page printer reviewed here that can handle 11-by-17-

### QMS ColorScript 100 Model 30 Fonts & Features

	Helvetica	Times	Courier	Line printer
	Bold Italic Sub Script Super Script Underline	Bold Italic Sub Script Super Script Underline	Bold Italic Sub Script Super Script Underline	Bold Italic Sub Script Super Script Underline
9.9-point				
10-point				
12-point				
14-point				
Scalable				

The QMS ColorScript 100 Model 30 comes with 35 standard Adobe PostScript fonts



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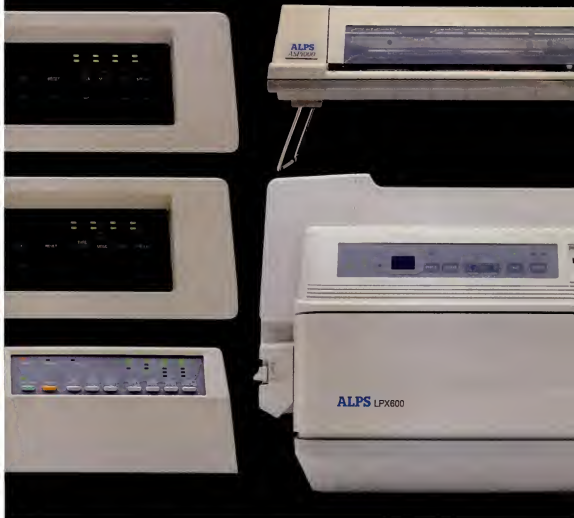
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**QMS COLORSCRIPT 100  
MODEL 30**



**PC  
FACT FILE**

QMS Inc., One Magnum Pass, Mobile, AL 36618; (800) 631-2592 ext. 904, (205) 633-4300  
List Price: \$15,995  
Dimensions (HWD): 24 x 20.75 x 19.5 in.  
Weight: 112.5 lbs.  
Emulations: PostScript, HPGL on-disk  
In Short: For graphic artists who want to print on 11- by 17-inch paper, QMS's Model 30 is the only way to go. Costing \$6,000 more than its newer sibling, the Model 10, the Model 30 can handle a duty cycle of up to 4,000 prints. The Model 30 produces excellent 300-dpi full-color images with special paper and a four-color thermal film ribbon. Adobe PostScript is resident.

CIRCLE 546 ON READER SERVICE CARD

between 22 and 83 cents apiece.

Most people won't use the ColorScript Model 30 for regular type, even though you can get all-black ribbons, and the printer comes with the full complement of 35 PostScript typefaces, plus an extra four more on floppy disk, which you can download to the Model 30's built-in 20MB hard disk. The reason is speed: the Model 30 managed just barely more than 2 pages per minute in the PC Labs test speed test. The all-black ribbon is most useful for producing color separations, a feature that is buried in the manual in the section headed "Printer Use and Care."

But it is under the graphics test that the printer struts its stuff. Blacks are solid and dark using the four-color ribbon. Colors are vivid and clean; even mixed colors come out looking extremely sharp and well-defined, with no signs of dithering. It's too bad that the process isn't very speedy; the graphics speed test took more than 14 minutes to run.

The Model 30 uses special cut-sheet paper. The color film ribbon sits in a large, removable tray, and is easy to install and change. The manual is very good, with

**It is in graphics that  
the QMS ColorScript 100  
Model 30 struts its  
stuff: the blacks are  
solid and dark; colors  
are vivid and clean.**

plenty of illustrations and information on using the printer with different systems and applications. The printer offers parallel, serial, and AppleTalk connectors.

The Model 30 also comes with some handy software and utilities. These include an HPGL emulation on-disk, plus an extra font and some useful test files. You'll also find a program that makes it easier to configure the printer.

If you're a graphic artist and need to print 11- by 17-inch pages or are likely to require 4,000 sheets a month, the Color-

Script 100 Model 30 is for you. But if legal size is the largest you need and 1,200 prints sounds like a lot, go directly to QMS's newer Model 10 and save \$6,000.

## Seiko Instruments CH-5504-PS

by M. David Stone

What do you do with a color thermal printer that has its own oddball command language? If you're Seiko, you bundle the printer with the PostScript interpreter, *Freedom of Press*, and sell it as a PostScript-compatible color printer. You say that's fine for Seiko, but would you want your sister to buy one? Well, that depends on how tight your sister's budget is. You see, the CH-5504-PS is admittedly kludgy, but at \$8,245 it's also the least-expensive 300-dot-per-inch color printer in this year's roundup—\$1,750 less than the next most expensive. And that alone makes the CH-5504-PS interesting.

Setting up the CH-5504 is simple. Measuring just 8.25 inches high by 13.5 inches wide by 25 inches deep, the printer is small enough to fit comfortably on your desk and light enough for one person to handle. Setup consists of mounting the ink sheet, take-up roll, and paper roll on spindles, installing the spindles in the printer, and setting the defaults through the front-panel buttons and LCD menu. And that's it—other than installing the software.

Most of the drawbacks of this printer stem from its reliance on *Freedom of Press*, from Custom Applications. The problem is not with *Freedom of Press* it-

### Seiko Instruments CH-5504-PS Fonts & Features

	Helvetica	Times	Courier	Line printer
	Bold Bk-Super Underline	Bold Bk-Super Underline	Bold Bk-Super Underline	Bold Bk-Super Underline
8 1/2-point				
10-point				
12-point				
14-point				
Scalable				

The Seiko CH-5504-PS relies on *Freedom of Press*, which has 35 PostScript-compatible fonts.

ink paper—a must for graphic artists who need to print two facing pages on a single sheet. The other benefit the Model 30 offers is an impressive duty cycle of 4,000 prints per month.

Based on the Mitsubishi G650 engine, the ColorScript uses thermal transfer to create its image. It can use any of three ribbons: all-black, three-color, or four-color. For the multicolor ribbons, the sheet makes multiple passes over the print head so that the colors are combined to make a full-color image. The paper is grabbed at its bottom edge and requires an unusually large bottom margin.

The four-color ribbon with its black component makes the best black image, but this is the slowest and most expensive choice. Since the film can be used just once, you get only about 125 pages from a four-color roll, compared with 150 for three-color and 390 for all black (using the 11- by 17-inch B-size roll). Not including paper, this means each page can cost be-

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self. The software program will convert PostScript files to bitmapped images for just about any laser printer and most inkjet and 24-pin impact dot matrix printers. It also provides a set of 35 scalable fonts to match the standard Adobe PostScript set. More recently, the program has added support for several color thermal printers and film recorders.

Judged as a utility, *Freedom of Press* is a useful program. After all, it's obviously a lot cheaper to buy a \$495 program that lets you use the printer you already have than to pay \$4,500 or more for a PostScript printer. But there are sacrifices involved—all of which are acceptable in a utility, but much harder to justify in a printer that requires the utility in order to work at all.

Among other drawbacks, *Freedom of Press* needs more than 4MB of disk space and a minimum of .5MB of expanded memory. For good performance on graphics, Custom Applications strongly recommends a math coprocessor. To use the program, you first have to print a file to disk.

#### SEIKO INSTRUMENTS CH-5504-PS



#### PC FACT FILE



Seiko Instruments Inc., 1130 Ringwood Ct., San Jose, CA 95131, (408) 922-5600.

List Price: \$8,245

Dimensions (HWD): 8.25 x 13.5 x 25 in.

Weight: 40 lbs

Emulations: PostScript-compatible through *Freedom of Press* software package.

In Short: The CH-5504-PS offers PostScript-compatible, 300-dpi, thermal color printing, with solid colors and good detail—all at the notably low price of \$8,245. However, because

PostScript compatibility comes through *Freedom of Press* on-disk, printing is more cumbersome than it should be. Still, you might think the extra work is worth the lower price.

CIRCLE 429 ON READER SERVICE CARD

then leave your application and tell *Freedom of Press* to print the file. *Freedom of Press* then interprets the file and sends the image to your printer—with a separate pass for each of the three colors.

A nice programming touch keeps you informed of the print job's status with a screen that shows the percentage of each step completed. The bad news is that you need the status screen: all this takes a long time, and without the status screen, you may get impatient.

To test the CH-5504-PS, we had to send all files through *Freedom of Press*. We timed speed tests from the moment we gave the order to print to the moment the page was finished. The results do not include the time required to print the file to disk.

On the graphics speed test, the package managed 9 minutes 50 seconds. While this is slow, it is well within the reasonable range for a PostScript printer. No doubt the speeds would be better with a faster hard disk, a faster computer, or the recommended math coprocessor, but it seems ironic that to make best use of this budget printer, you need a state-of-the-art computer.

Also helping ease the speed problem is that once you've sent the image from your computer, you can use the Local Print feature to print another copy in about 1.5 minutes. What's more, you can set local print for up to 99 copies at a time. PC Labs was not able to run text speed tests because *Freedom of Press* would not accept the file produced by printing the speed test to disk.

Graphics quality is superb, when it works, with brilliant colors and sharp detail. In our tests, the printer occasionally lost alignment, offsetting one color from the others. Text is also good, except for the Courier font, which is so thin that the lines tend to break. A nice bonus that comes with using a paper roll is that the CH-5504 can print almost to the top and bottom edges of the page—unlike color printers that use single sheets and need a wide margin of white space to hold on to the paper.

All told, the CH-5504-PS is a mixed bag. The quality of output is generally good, and the \$8,245 price is significantly lower than the closest competition. But as long as *Freedom of Press* is the only way to print on the CH-5504-PS, it will remain a clumsy printer. A Seiko representative says the company is currently negotiating with two software houses to provide driv-



#### EDITOR'S CHOICE

##### QMS ColorScript 100 Model 10

In the color page printer arena, the QMS ColorScript 100 Model 10 truly shines. Its 300-dot-per-inch output is beyond reproach, with exquisite detail and brilliant colors. And at \$9,995, the Model 10 is the first color PC page printer with on-board Adobe PostScript for less than \$10,000. For boardroom presentations and four-color final page proofs, the Model 10 is a superb choice.

Honorable mention goes to the Model 10's older, bigger sibling, the Model 30, which has some capabilities the Model 10 doesn't. For \$10,000 less than its original price but \$6,000 more than the Model 10, the Model 30 supports 11- by 17-inch paper, which lets graphic artists survey a two-page spread on one sheet. And the Model 30 supports a heavier duty cycle; it handles 4,000 pages per month, compared with the Model 10's 1,200-page duty cycle.

ers for the printer's native command set. But the support is not there now. If your budget is tight and you must have a 300-dpi color thermal printer, the CH-5504-PS is worth a look, but also look at the QMS ColorScript 100 Model 10, at \$9,995, and see how far your budget can stretch.

## Tektronix Phaser CP

by Gerard Kunkel

When the name Tektronix comes up, *printer* isn't the first word that pops into people's minds. But, with the spring 1989 introduction of the \$12,995 Phaser CP, the company known for its engineering products made a clear commitment to boardroom-quality graphic prints on a desktop device.

Installing the Phaser system is straightforward, except for moving the Phaser CP engine—don't try it alone. And give yourself a chunk of time: the Phaser system comes with a substantial amount of software to be loaded. Installing the software means shuffling 15 low-density 5.25-inch or five 3.5-inch disks. Much like a *Micro-soft Windows* installation, this daunting

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procedure requires about 3MB of hard disk space.

The Phaser CP system is a combination of an 8-bit printer controller card and a hefty 99-pound thermal wax-transfer print engine. The engine operates by feeding coated paper back and forth four times (there is an optional three-pass ribbon), layering cyan, yellow, magenta, and black wax to create full-color images. The forward/reverse mechanisms performed flawlessly to create a registration that would do a professional printer proud.

There are two main advantages to the wax transfer process of the Phaser CP. The first is the brilliance of color. Primary colors are intensely rich. The other plus is in the creation of overhead transparencies. Since the wax is somewhat transparent, the colors appear smooth and brilliant when projected.

One caveat is that the wax transfer process does not create the most durable of surfaces. If dragged across the printout, a simple paper clip or other office supply can mar the surface.

Tektronix uses its own PostScript, Version 1.0, which includes the standard 35 PostScript fonts; all of the PostScript language interpretation takes place in the Phaser card's ROM. A standard 8MB of RAM is used for font caching and page construction.

Once installed, the Phaser card thinks like a communications or printer port, operating with either COM or LPT ports. After PC testing, we tried this adapter card in a system with a network card. There was an initial conflict that was rectified by a simple modification of the network card's interrupt jumpers. From that point on, the

**PRINTERS**  
**COLOR PAGE**

**TEKTRONIX PHASER CP**



**PC FACT FILE**

Tektronix Inc., P.O. Box 1000, Mail Sta. 63-447, Wilsonville, OR 97070; (800) 835-6100.  
 List Price: \$12,995  
 Dimensions (HWD): 12.25 x 35 x 19.25 in.  
 Weight: 99 lbs.  
 Emulations: PostScript emulation (on-disk), HPGL.  
 In Short: When introduced, the Phaser made a price breakthrough. Now its price falls in the middle range of color PostScript printers. This high-quality wax-transfer printer offers both PostScript and HPGL on-disk. The downside to this printer is the approximate \$1.50 cost per print and limited support of downloadable fonts.

**CIRCLE 847 ON READER SERVICE CARD**

Phaser CP resided peacefully as a local printer (COM1) with three other printers on the network (LPT1, LPT2, LPT3).

If you are an AutoCAD user and prefer printing to a plotter interface, the Phaser system has added HPGL compatibility (not tested here) that prints in one HPGL font. A setup utility accessible from DOS lets you switch from PostScript to HPGL. Within the same utility program you can set pen widths and pen colors as if it were an HP1475a plotter.

Like other color page printers, the Tektronix printer is not a speed demon; you'll find that the price for quality isn't paid only in dollars. In PC Labs tests, test pages ran at about 1 page per minute. The graphics test came in at an unsurprising 12 minutes, 16 seconds.

If you go with the Tektronix Phaser CP instead of the QMS ColorScript 100 Model 30, you'll save an initial \$3,000—although that may be quickly devoured by the approximate \$1.50 cost of each print made with the Phaser. And, although you'll gain even better color, you'll lose on-board Adobe PostScript and 11- by 17-inch output.

**Tektronix Phaser CP**  
**Fonts & Features**

	Helvetica	Times	Courier	Line printer
	Bold	Sub-Super	Bold	Sub-Super
8.9-point	■	■	■	■
10-point	■	■	■	■
12-point	■	■	■	■
14-point	■	■	■	■
Scalable	■	■	■	■

The Tektronix Phaser CP lets you switch from its PostScript emulator fonts to the HPGL font through a setup utility or DOS.

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**EDITOR'S CHOICE**  
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#### AVAILABLE OPTIONS

- Full-size vertical case or mini-tower case
- RAM upgrade to 2-, 4-, 8-, 12-, or 16-MB using DIMs and/or SIMMs
- Numeric coprocessor: 80387 or iWitek
- 20MB to 300MB hard drives with MFM, RLL, ESDI, or SCSI interface
- 40MB - 120MB tape backup drive
- Available in standard monochrome (720x348, amber), standard VGA (640x480, color) or extended VGA (800x600 up to 1024x768, color)
- 1 44MB 3.5" diskette drive

\$3649

### DATA 386-25<sup>+</sup>

#### STANDARD CONFIGURATION

- Intel 80386-25 microprocessor
- 1MB base memory RAM, expandable to 16MB of 32-bit memory
- 84K of 25ns static RAM cache
- 66MB, 25ns Hard Disk (many other sizes available as an option)
- Ondisk Programmer Plus VGA card, 512K capable of 1024x768 with 16 colors
- NEC Multisync II monitor capable of 1024x768 interlaced
- Built-in ROM setup and diagnostics with EGA/VGA selection
- Socket for Intel 80387-25 or iWitek numeric coprocessor
- 1 32-bit, 1 8-bit and 1 16-bit slots
- 1 1:1 dual hard/floppy controller
- 1 2MB 5.25" floppy drive
- Enhanced 101-key "click" touch keyboard
- 1 parallel and 2 serial ports
- 230W power supply

#### AVAILABLE OPTIONS

- Full-size vertical case
- RAM upgrade to 2-, 4-, 8-, 12-, or 16-MB
- Numeric coprocessor: 80387 or iWitek
- 20MB to 300MB hard drives with MFM, RLL, ESDI, or SCSI interface
- 40MB - 120MB tape backup drive
- Available in standard monochrome (720x348, amber), standard VGA (640x480, color) or extended VGA (800x600 up to 1024x768, color)
- 1 44MB 3.5" diskette drive

\$4649

### DATA 386-16<sup>+</sup> / -20<sup>+</sup> / -25<sup>+</sup>

#### STANDARD CONFIGURATION

- Intel 80386-16, -20, or -25 microprocessor
- 1MB base RAM, expandable to 16MB of 32-bit memory
- LM 8545 4.0 driver supplied
- 25 MHz system features Intel 82385 cache controller with 32K 2-way set associative static cache
- 66MB, 25ns Hard Disk (many other sizes available as an option)
- Ondisk Programmer Plus VGA card, 512K capable of 1024x768 with 16 colors
- NEC Multisync II monitor capable of 1024x768 interlaced
- Socket for Intel 80387 numeric coprocessor
- 1 32-bit, 5 16-bit and 2 8-bit slots
- 1 1:1 dual hard/floppy controller
- 1 2MB 5.25" floppy drive
- Enhanced 101-key "click" touch keyboard
- 1 parallel and 2 serial ports
- 230W power supply

#### AVAILABLE OPTIONS

- Full-size vertical case
- RAM upgrade to 2-, 4-, 8-, 12-, or 16-MB
- Numeric coprocessor: 80387
- 20MB to 300MB hard drives with MFM, RLL, ESDI, or SCSI interface
- 40MB - 120MB tape backup drive
- Available in standard monochrome (720x348, amber), standard VGA (640x480, color) or extended VGA (800x600 up to 1024x768, color)
- 1 44MB 3.5" diskette drive

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### PORTACOMP II

#### STANDARD CONFIGURATION

- Intel 80286-12 microprocessor
- 512K base memory, expandable to 4MB on board
- Socket for Intel 80287-10 numeric coprocessor
- Two available 16-bit expansion slots
- Gas Plasma 9" TFT display
- 640x480 resolution - EGA
- Dual hard/floppy controller
- 1 44MB 3.5" internal AMD 1.2MB 5.25" external diskette drives
- 20MB, 10ms hard drive
- Enhanced 102-key "click" touch keyboard
- 1 parallel and 2 serial ports
- 8-pin external monitor output port - EDA
- 150W power supply

#### AVAILABLE OPTIONS

- 16MHz available soon
- Memory expansion to 640K, 1MB, 2MB, or 4MB
- 40 - 150MB hard drives with MFM, RLL, ESDI, or SCSI interface
- Numeric coprocessor: 80287
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**AEG Olympia NP 80-24**

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Text Speed: **DEFAULT** 115 cps  
 0 50 100 150 200 cps 52 cps

Graphics Speed: **IBM PROPORTIONER 324** 1 min. 20 sec.  
 0 5 1 1.5 2 2.5 3 gppm 0.8 gppm



Once you've torn down  
 laws in the country  
 yourself face to face  
 Devil, what will you  
 10CPI Bold Underline  
 NLQ 10CPI Bold Under  
 Proportional 10CPI Bold

**AEG Olympia NP 136-24**

\$799 24-pin wide-carriage dot matrix



Text Speed: **DEFAULT** 118 cps  
 0 50 100 150 200 cps 81 cps

Graphics Speed: **IBM PROPORTIONER 324** 49 sec.  
 0 5 1 1.5 2 2.5 3 gppm 1.2 gppm



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**Amstrad DMP3000**

\$300 9-pin dot matrix



Text Speed: **QUALITY** 59 cps  
 0 50 100 150 200 cps 19 cps

Graphics Speed: **IBM PROPORTIONER** 1 min. 32 sec.  
 0 5 1 1.5 2 2.5 3 gppm 0.7 gppm



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 Devil, what will you  
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 NLQ Pica Bold Underl

**Amstrad LQ 3500**

\$500 24-pin dot matrix



Text Speed: **QUALITY** 32 cps  
 0 50 100 150 200 cps 32 cps

Graphics Speed: **IBM PROPORTIONER** 1 min. 35 sec.  
 0 5 1 1.5 2 2.5 3 gppm 0.6 gppm



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 ulPica Bold Underline  
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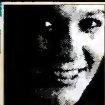
**AT&T 570**

\$695 9-pin dot matrix



Text Speed: **DEFAULT** 124 cps  
 0 50 100 150 200 cps 28 cps

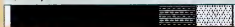
Graphics Speed: **IBM PROPORTIONER** 52 sec.  
 0 5 1 1.5 2 2.5 3 gppm 1.2 gppm



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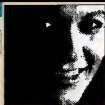
**Blue Chip M200/NLQ**

\$299 9-pin dot matrix



Text Speed: **DEFAULT** 44 cps  
 0 50 100 150 200 cps 18 cps

Graphics Speed: **IBM PROPORTIONER** 1 min. 31 sec.  
 0 5 1 1.5 2 2.5 3 gppm 0.7 gppm



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 laws in the country  
 yourself face to face  
 Devil, what will you  
 10CPI Bold Underline  
 NLQ 10CPI Bold Under  
 Proportional 10CPI B  
 ded



**Citizen GSX-140**

\$499 24-pin dot matrix with color option



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Devil, what will you  
Draft **Bold Underline**  
10CPI **Bold Underline**  
Proportional 10CPI **Bold**

**C. Itoh 5000**

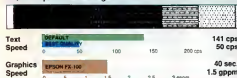
\$1,995 18-pin wide-carriage dot matrix



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Devil, what will you  
10CPI **Bold Underline**  
12CPI **Bold Underline** Com  
Proportional 10CPI **Bold**

**Epson FX-1050**

\$799 9-pin wide-carriage dot matrix



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Devil, what will you  
Pica **Bold Underline**  
NLQ Pica **Bold Underline**  
Proportional **Bold Underline**

**Epson LQ-510**

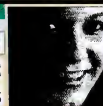
\$529 24-pin dot matrix



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Devil, what will you  
Draft **Bold Underline**  
Courier **Bold Underline**  
Proportional **Bold Underline**

**Epson LX-810**

\$299 9-pin dot matrix



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Devil, what will you  
Draft **Bold Underline**  
NLQ Pica **Bold Underline**

**Facit B2400**

\$699 24-pin dot matrix



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Devil, what will you  
10CPI **Bold Underline**  
NLQ 10CPI **Bold Underline**  
Proportional 10CPI **Bold**  
ed



## Fortis DM 2210

\$499 9-pin dot matrix



Text Speed: 131 cps (IBM Proprinter), 38 cps (Epson FX)

Graphics Speed: 23 sec. (IBM Proprinter), 2.6 gppm (Epson FX)



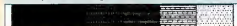
Pica Bold Underline  
Elite Bold Underline  
NLQ Pica Bold Underline

Typefaces not in emulation

Proportional Bold Underline  
Courier Bold Underline

## Fortis DM 2215

\$599 9-pin wide-carriage dot matrix



Text Speed: 132 cps (IBM Proprinter), 38 cps (Epson FX)

Graphics Speed: 42 sec. (IBM Proprinter), 1.4 gppm (Epson FX)



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yourself face to face  
Devil, what will you  
Pica Bold Underline  
NLQ Pica Bold Underline  
Proportional Bold Underline

## Fortis DQ 4110

\$499 24-pin dot matrix



Text Speed: 100 cps (IBM Proprinter), 49 cps (Epson FX)

Graphics Speed: 46 sec. (IBM Proprinter), 1.3 gppm (Epson FX)



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yourself face to face  
Devil, what will you  
Pica Bold Underline  
NLQ Pica Bold Underline  
NLQ Proportional Bold Underline

## Fortis DQ 4210

\$699 24-pin dot matrix



Text Speed: 122 cps (IBM Proprinter), 50 cps (Epson FX)

Graphics Speed: 25 sec. (IBM Proprinter), 2.4 gppm (Epson FX)



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Devil, what will you  
Pica Bold Underline  
NLQ Pica Bold Underline  
NLQ Proportional Bold Underline

## Genicom 3410XLQ

\$2,175 18-pin dot matrix



Text Speed: 150 cps (IBM Proprinter), 82 cps (Epson FX)

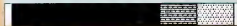
Graphics Speed: 55 sec. (IBM Proprinter), 1.1 gppm (Epson FX)



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laws in the country  
yourself face to face  
Devil, what will you  
10CPI Bold Underline  
NLQ 10CPI Bold Underline  
Proportional 10CPI Bold Underline

## Genicom 3820

\$2,475 18-pin wide-carriage dot matrix



Text Speed: 235 cps (IBM Proprinter), 104 cps (Epson FX)

Graphics Speed: 34 sec. (IBM Proprinter), 1.8 gppm (Epson FX)



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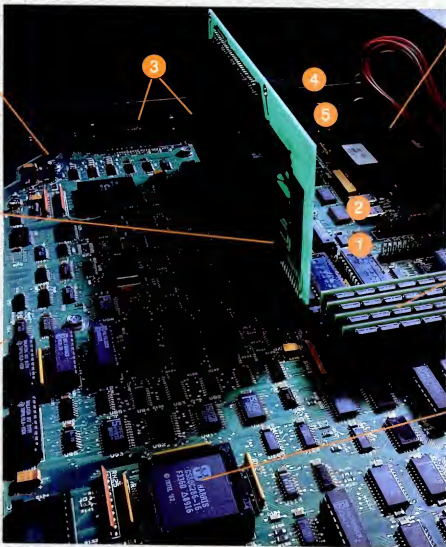
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### CompuAdd 810, Only \$595.

*As shown, with Color VGA monitor and 20MB hard drive, \$1410.*

- NEC V20<sup>®</sup> processor running at 10MHz.
- 640KB RAM with parity checking.
- Built-in dual IDE hard drive interface.
- Built-in dual diskette drive controller.
- Built-in parallel printer port.
- Two built-in serial ports.
- Three full-size expansion slots.
- Built-in game port interface.
- 8087 math coprocessor support.
- 5.25" 360KB diskette drive.
- Optional real time clock.
- 101-key enhanced keyboard.
- 145 watt power supply.



### CompuAdd 212, Only \$895.

*As shown, with Color VGA monitor and 20MB hard drive, \$1799.*

- 80286 processor running at 12MHz.
- 512KB RAM expandable to 4MB on motherboard.
- 0 wait state page-mode memory.
- Built-in dual IDE hard drive interface.
- Built-in dual diskette drive controller.
- Built-in parallel printer port.
- Two built-in serial ports.
- Five expansion slots: three full-size 16-bit and two half-size 8-bit.
- Built-in game port interface.
- 80287 math coprocessor support.
- Choice of 5.25" 1.2MB or 3.5" 1.44MB diskette drive.
- Real time clock.
- 101-key enhanced keyboard.



### CompuAdd 216, Only \$995.

*As shown, with Color VGA monitor and 40MB hard drive, \$2039.*

- 80286 processor running at 16MHz.
- 512KB RAM expandable to 4MB on motherboard.
- 0 wait state page-mode memory.
- Built-in dual IDE hard drive interface.
- Built-in dual diskette drive controller.
- Built-in parallel printer port.
- Two built-in serial ports.
- Five expansion slots: three full-size 16-bit and two half-size 8-bit.
- Built-in game port interface.
- 80287 math coprocessor support.
- Choice of 5.25" 1.2MB or 3.5" 1.44MB diskette drive.
- Real time clock.
- 101-key enhanced keyboard.



### CompuAdd 316s, Only \$1495.

*As shown, with Color VGA monitor and 40MB hard drive, \$2539.*

- 80386SX processor running at 16MHz.
- 1MB RAM expandable to 4MB on motherboard.
- 0 wait state page-mode memory.
- Built-in dual IDE hard drive interface.
- Built-in dual diskette drive controller.
- Built-in parallel printer port.
- Two built-in serial ports.
- Five expansion slots: three full-size 16-bit and two half-size 8-bit.
- Built-in game port interface.
- 80387SX math coprocessor support.
- Choice of 5.25" 1.2MB or 3.5" 1.44MB diskette drive.
- Real time clock.
- 101-key enhanced keyboard.
- One year's free on-site service.

1. Open the foldout page
2. Insert this sheet with
  1. Front side touching the free page
  2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet

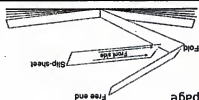


### Foldout slip-sheet



### Inverted foldout slip-sheet

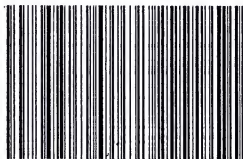
1. Open the foldout page
2. Insert this sheet with



1. Front side touching the free page
2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet

1. Follow instructions on the other side

Inverted Back



Gbs5lipBack-0018

Back

1. Follow instructions on the other side



Over the last few years, CompuAdd has taken its share of awards in the trade press, from "Editor's Choice" to "Best Buy." Despite that, we're changing our entire line. Because, no matter how good we get, we'll never stop looking for ways to improve.

Our new line not only gives you more reliability, it gives you back more of your desk. The profile is lower and the footprint is 30% smaller. But you're not giving up anything other than size. Our 286 systems have always been best sellers, with proven reliability and 100% IBM®-compatibility. And now they're even better.



The service is over  
the phone, over the counter  
or overnight.

No other computer company is as customer driven as CompuAdd. You can tell by the service and support we offer. It's among the best in the business.

To begin with, if your CompuAdd computer isn't everything we said it would be, just return it within the first 30 days. We'll give you your money back. No questions asked.

We guarantee each computer for a full year. You can call our technical and customer support center, toll-free. We've found that over 90% of our customers' questions can be answered over the phone. Or you can bring your system to one of our company-owned

CompuAdd Superstore repair centers. We also offer on-site service within over 260 Memorex Telex service areas nationwide. And for the CompuAdd 220 and above, on-site service is free for one year.



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the phone, over the counter  
or over coffee.

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an even more powerful  
statement.**

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**CompuAdd 325, \$3899**

386/25 that comes complete with 40MB hard drive, Monochrome VGA monitor, high speed static RAM cache and 101-key enhanced keyboard. \$4149 with Color VGA monitor. Call for hard drive options.

**CompuAdd 320, \$3095**

386/20 that comes complete with 40MB hard drive, Monochrome VGA monitor, high speed static RAM cache and 101-key enhanced keyboard. \$3345 with Color VGA monitor. Call for hard drive options.

**CompuAdd 316, \$2649**

386/16 that comes complete with 40MB hard drive, Monochrome VGA monitor, disk caching software and 101-key enhanced keyboard. \$2899 with Color VGA monitor. Call for hard drive options.

**CompuAdd 220, \$2449**

286/20 that comes complete with 40MB hard drive, Monochrome VGA monitor, disk caching software and 101-key enhanced keyboard. \$2699 with Color VGA monitor. Call for hard drive options.

# CompuAdd

**Customer driven, by design.™**

**Hyundai HDP-910**

\$259 9-pin dot matrix



Text Speed: **DEFAULT** **BEST QUALITY** 54 cps / 23 cps

Graphics Speed: **IBM GRAPHICS 810** 35 sec. / 1.7 gppm



Once you've torn down  
laws in the country and  
yourself face to face  
Devil, what will you hide  
Pica Bold Underline  
NLQ Pica Bold Underline  
Proportional Bold Underline

**Hyundai HDP-920**

\$349 9-pin wide-carriage dot matrix



Text Speed: **DEFAULT** **BEST QUALITY** 52 cps / 22 cps

Graphics Speed: **IBM GRAPHICS 810** 36 sec. / 1.7 gppm



Once you've torn down  
laws in the country and  
yourself face to face  
Devil, what will you hide  
Pica Bold Underline  
NLQ Pica Bold Underline  
Proportional Bold Underline

**Hyundai HDP-1810**

\$399 18-pin dot matrix



Text Speed: **DEFAULT** **BEST QUALITY** 87 cps / 42 cps

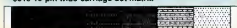
Graphics Speed: **IBM GRAPHICS 810** 37 sec. / 1.6 gppm



Once you've torn down  
laws in the country and  
yourself face to face  
Devil, what will you hide  
Pica Bold Underline  
NLQ Pica Bold Underline  
Proportional Bold Underline

**Hyundai HDP-1820**

\$519 18-pin wide-carriage dot matrix



Text Speed: **DEFAULT** **BEST QUALITY** 57 cps / 43 cps

Graphics Speed: **EPSON FX-100** 1 min. 15 sec. / 0.8 gppm



Once you've torn down  
laws in the country and  
yourself face to face  
Devil, what will you hide  
Pica Bold Underline  
NLQ Pica Bold Underline  
Proportional Bold Underline

**IBM Proprinter X24E**

\$899 24-pin dot matrix



Text Speed: **DEFAULT** **BEST QUALITY** 100 cps / 56 cps

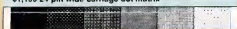
Graphics Speed: **IBM PROPRINTER X24** 1 min. 8 sec. / 0.8 gppm



Once you've torn down all  
laws in the country and  
yourself face to face with  
Devil, what will you hide  
10CPI Bold Underline  
NLQ 10CPI Bold Underline  
Proportional 10CPI Bold Underline

**IBM Proprinter XL24E**

\$1,199 24-pin wide-carriage dot matrix



Text Speed: **DEFAULT** **BEST QUALITY** 159 cps / 81 cps

Graphics Speed: **IBM PROPRINTER XL24** 1 min. 4 sec. / 0.8 gppm



Once you've torn down all  
laws in the country and  
yourself face to face with  
Devil, what will you hide  
12CPI Bold Underline  
NLQ 10CPI Bold Underline  
Proportional 10CPI Bold Underline

## Laser 190E

\$370 9-pin dot matrix



Text Speed: 90 cps  
BEST QUALITY: 24 cps

Graphics Speed: 1 min. 20 sec.  
0.8 gppm

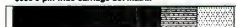


Once you've torn down  
laws in the country  
yourself face to fac  
Devil, what will you  
Pica Bold Underline  
NLQ Pica Bold Underl

Proportional Bold Under

## Laser 240

\$600 9-pin wide-carriage dot matrix



Text Speed: 147 cps  
BEST QUALITY: 37 cps

Graphics Speed: 1 min. 8 sec.  
0.9 gppm



Once you've torn down  
laws in the country  
yourself face to fac  
Devil, what will you  
Pica Bold Underline  
NLQ Pica Bold Underl  
Proportional Bold Under

## Mannesmann Tally 81

\$229 9-pin dot matrix



Text Speed: 73 cps  
BEST QUALITY: 23 cps

Graphics Speed: 2 min. 10 sec.  
0.5 gppm



Once you've torn down all  
laws in the country and  
yourself face to face wi  
Devil, what will you hid  
12CPI Bold Underline Com  
NLQ 10CPI Bold Under  
Proportional 10CPI Bo  
ded

## NEC Pinwriter P2200XE

\$499 24-pin dot matrix



Text Speed: 95 cps  
BEST QUALITY: 46 cps

Graphics Speed: 3 min. 27 sec.  
0.3 gppm



Once you've torn down all c  
laws in the country and you  
yourself face to face with the  
Devil, what will you hide be  
Courier Bold Underline  
Souvenir Bold Underl  
Proportional Bold Underline

## Okidata Microline 172

\$289 9-pin dot matrix



Text Speed: 83 cps  
BEST QUALITY: 35 cps

Graphics Speed: 31 sec.  
1.9 gppm



Once you've torn down  
laws in the country  
yourself face to fac  
Devil, what will you  
HSD Bold Underline C  
NLQ Bold Underline C

## Okidata Microline 182 Turbo

\$339 9-pin dot matrix



Text Speed: 95 cps  
BEST QUALITY: 37 cps

Graphics Speed: 29 sec.  
2.1 gppm



Once you've torn down  
laws in the country  
yourself face to fac  
Devil, what will you  
HSD Bold Underline C  
NLQ Bold Underline C

**Output Technology 560DL**

\$1,995 9-pin wide-carriage dot matrix



Text Speed: **DEFAULT** **BEST QUALITY** 147 cps / 82 cps

Graphics Speed: **IBM PROPRINTER XL** 54 sec. / 1.1 gppm



Once you've torn down  
laws in the country  
yourself face to fac  
Devil, what will you  
10CPI Bold Underline  
NLQ 10CPI Bold Under  
Proportional 10CPI B

**Panasonic KX-P1124**

\$530 24-pin dot matrix



Text Speed: **DEFAULT** **BEST QUALITY** 87 cps / 41 cps

Graphics Speed: **EPSON LQ-2500** 2 min. 15 sec. / 0.5 gppm



Once you've torn down  
laws in the country and  
yourself face to face wit  
Devil, what will you hide  
Draft Bold Underline  
Courier Bold Underli  
Bold PS Bold Underline

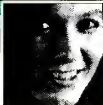
**Panasonic KX-P1180**

\$300 9-pin dot matrix



Text Speed: **DEFAULT** **BEST QUALITY** 59 cps / 24 cps

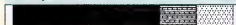
Graphics Speed: **IBM PROPRINTER** 1 min. 35 sec. / 0.6 gppm



Once you've torn down  
laws in the country a  
yourself face to face  
Devil, what will you h  
Pica Bold Underline  
NLQ Pica Bold Underl  
Bold PS Bold Underline

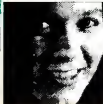
**Panasonic KX-P1191**

\$400 9-pin dot matrix



Text Speed: **DEFAULT** **BEST QUALITY** 65 cps / 35 cps

Graphics Speed: **IBM PROPRINTER** 1 min. 28 sec. / 0.7 gppm



Once you've torn down  
laws in the country  
yourself face to fac  
Devil, what will you  
Pica Bold Underline  
NLQ Pica Bold Underl  
Bold PS Bold Underli

**Selkosh BP-5460**

\$1,999 8-pin wide-carriage dot matrix



Text Speed: **DEFAULT** **BEST QUALITY** 236 cps / 92 cps

Graphics Speed: **IBM GRAPHICS 5100** 10 sec. / 6.1 gppm



Once you've torn down  
laws in the country a  
yourself face to face  
Devil, what will you h  
Pica Bold Underline  
High Quality Bold Underl  
Proportional Bold Unde

**Selkosh SL-230AI**

\$1,149 24-pin wide-carriage dot matrix



Text Speed: **DEFAULT** **BEST QUALITY** 77 cps / 49 cps

Graphics Speed: **IBM PROPRINTER XL** 43 sec. / 1.4 gppm



Once you've torn down  
laws in the country  
yourself face to fac  
Devil, what will you  
10CPI Bold Underline  
NLQ 10CPI Bold Under  
Proportional 10CPI Bo

**Seikosha SP-1600AI**

\$329 9-pin dot matrix



Text Speed: **DEFAULT QUALITY** 79 cps  
 0 50 100 150 200 cps  
 27 cps

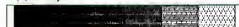
Graphics Speed: **IBM GRAPHICS 2.35** 37 sec.  
 0 5 1 1.5 2 2.5 3 gppm  
 1.6 gppm



Once you've torn down  
 laws in the country  
 yourself face to face  
 Devil, what will you  
 Pica Bold Underline  
 NLQ Bold Underline Compress  
 Elite Bold Underline Compr

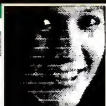
**Siemens Ink Jet PT 90-12**

\$1,500 ink jet



Text Speed: **QUALITY** 136 cps  
 0 50 100 150 200 cps  
 100 cps

Graphics Speed: **IBM GRAPHICS 2.35** 38 sec.  
 0 5 1 1.5 2 2.5 3 gppm  
 1.6 gppm



Once you've torn down  
 laws in the country  
 yourself face to face  
 Devil, what will you  
 10CPI Bold Underline  
 NLQ 10CPI Bold Under  
 Proportional 10CPI Bold

**Siemens PT 88S-32**

\$718 Ink jet



Text Speed: **QUALITY** 97 cps  
 0 50 100 150 200 cps  
 33 cps

Graphics Speed: **IBM GRAPHICS 2.35** 48 sec.  
 0 5 1 1.5 2 2.5 3 gppm  
 1.3 gppm



Once you've torn down al  
 laws in the country and  
 yourself face to face wi  
 Devil, what will you h  
 10CPI Bold Underline

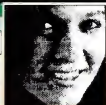
**Star Micronics XR-1500 Multi Font**

\$799 9-pin wide-carriage dot matrix with color option



Text Speed: **DEFAULT QUALITY** 127 cps  
 0 50 100 150 200 cps  
 49 cps

Graphics Speed: **IBM PROPORTION** 39 sec.  
 0 5 1 1.5 2 2.5 3 gppm  
 1.5 gppm



Once you've torn down  
 laws in the country  
 yourself face to face  
 Devil, what will you  
 10CPI Bold Underline  
 NLQ 10CPI Bold Under  
 NLQ 10CPI Bold Under

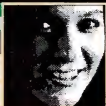
**Star Micronics XB-2410 Multi Font**

\$749 24-pin dot matrix with color option



Text Speed: **DEFAULT QUALITY** 117 cps  
 0 50 100 150 200 cps  
 29 cps

Graphics Speed: **IBM PROPORTION** 44 sec.  
 0 5 1 1.5 2 2.5 3 gppm  
 1.4 gppm



Once you've torn down  
 laws in the country  
 yourself face to face  
 Devil, what will you  
 10CPI Bold Underline  
 NLQ 10CPI Bold Under  
 Proportional 10CPI Bold

**Tandy DMP 107**

\$280 9-pin dot matrix



Text Speed: **DEFAULT QUALITY** 48 cps  
 0 50 100 150 200 cps  
 16 cps

Graphics Speed: **IBM GRAPHICS 2.35** 53 sec.  
 0 5 1 1.5 2 2.5 3 gppm  
 1.1 gppm



Once you've torn down  
 laws in the country a  
 yourself face to face  
 Devil, what will you b  
 10 pitch Bold Underl  
 NLQ Bold Underline C  
 PS Bold Underline Com



**Tandy DMP 133**

\$380 9-pin dot matrix



Text Speed: **DEFAULT** **BEST QUALITY** 67 cps / 24 cps

Graphics Speed: **IBM GRAPHICS XL24** 42 sec. / 1.4 gppm



Once you've torn down  
laws in the country a  
yourself face to face  
Devil, what will you h  
Draft Bold Underline C  
LQ Bold Underline Com  
LQ PS Bold Underline

**Tandy DMP 300**

\$649 24-pin dot matrix



Text Speed: **DEFAULT** **BEST QUALITY** 132 cps / 51 cps

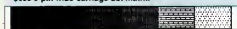
Graphics Speed: **IBM PRINTER XL24** 1 min. 36 sec. / 0.63 gppm



Once you've torn down  
laws in the country and  
yourself face to face w  
Devil, what will you hid  
10CPI Bold Underline  
NLQ 10CPI Bold Under  
Proportional 10CPI Bol

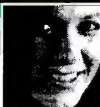
**Tandy DMP 442**

\$699 9-pin wide-carriage dot matrix



Text Speed: **DEFAULT** **BEST QUALITY** 160 cps / 60 cps

Graphics Speed: **IBM PROPRINTER** 37 sec. / 1.6 gppm



Once you've torn down  
laws in the country  
yourself face to fac  
Devil, what will you  
10CPI Bold Underline  
NLQ 10CPI Bold Under  
Proportional 10CPI Bol

**Tandy DMP 2102**

\$999 24-pin wide-carriage dot matrix



Text Speed: **DEFAULT** **BEST QUALITY** 136 cps / 51 cps

Graphics Speed: **IBM PROPRINTER** 1 min. 35 sec. / 0.6 gppm



Once you've torn down  
laws in the country and  
yourself face to face w  
Devil, what will you hid  
10CPI Bold Underline  
NLQ 10CPI Bold Under  
Proportional 10CPI Bol

**Unisys AP 1324**

\$1,850 24-pin wide-carriage dot matrix



Text Speed: **DEFAULT** **BEST QUALITY** 117 cps / 66 cps

Graphics Speed: **EPSON LQ280** 42 sec. / 1.4 gppm



Once you've torn down  
laws in the country  
yourself face to fac  
Devil, what will you  
Draft Bold Underline  
Courier Bold Underli  
Proportional Bold Under

**Unisys AP 1327**

\$450 9-pin dot matrix



Text Speed: **DEFAULT** **BEST QUALITY** 124 cps / 38 cps

Graphics Speed: **IBM PROPRINTER** 48 sec. / 1.2 gppm



Once you've torn down  
laws in the country  
yourself face to fac  
Devil, what will you  
10CPI Bold Underline  
NLQ 10CPI Bold Under



# The Total Scanner Solution

## NEW

**Handy Scanner 3000 Plus**

including PC Paintbrush Plus

- DESKTOP PUBLISHING
- WORD PROCESSING
- DATA BASE APPLICATIONS
- HIGH LEVEL LANGUAGE INTERFACE
- CAD APPLICATIONS



DFI expands the world of desktop scanning with the new Handy Scanner 3000 Plus. Consolidating all the advanced hardware features you have come to expect from the company that introduced hand scanners to the world, our scanner now gives even sharper images and is even easier to use. Perhaps, most important, DFI gives total scanning support: desktop publishing, word processing, data base, high level language development and CAD applications.

The Handy Scanner 3000 Plus comes bundled with ZSoft's top-selling PC Paintbrush Plus and DFI's SCAN and ImageTools programs. PC Paintbrush Plus lets you paint, rotate, flip, invert, shrink, tilt, expand and add text into your scanned images. Using SCAN, you can save your images into TIFF, PCX, IMG, MSP, and CUT image files or convert between the formats. Using ImageTools, you can interface the Handy Scanner 3000 Plus with dBase IV, dBase III+, and compatibles such as Clipper, Foxbase or design custom applications using Microsoft C and QuickBASIC, or Turbo Pascal.

Available as options are DFI's OCR package, which reads mono or proportional spaced typeset characters in English, German, French, and Spanish languages and a fast CAD conversion program that allows you to save and convert scanned images into CAD image formats. At DFI, we offer you the total scanning solution. The Handy Scanner 3000 Plus, a new age in scanning technology.

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MONOCHROME  
DOT MATRIX PRINTERS

# NOT DEAD YET

As lasers threaten  
to take over,  
dot matrix printers are  
fighting back with  
better paper handling,  
friendlier front  
panels, and even  
lower prices.

*by Stephanie K. Losee*

I know what you're thinking. Dot matrix printers are going the way of the daisy wheel, sputtering to a gruesome end at the hands of lethal lasers. You're thinking that there's nothing new under the dot matrix sun, and that you may as well skip this section and turn to the *real* news.

Wrong.

It's laser printers that are making the dot matrix market so intriguing this year. More to the point, it's the price of lasers that's affecting the dot matrix printer pro-

**Good news for  
the buyer: high-end 24-pin  
dot matrix models  
are already lowering their  
prices to remain  
competitive. Their street  
prices run \$500-\$1,500.**

foundly. Laser prices are falling rapidly, and not because the vendors are hacking off vital features. The 4-page-per-minute HP LaserJet Series IIP (reviewed in this issue) broke the \$1,500 barrier without losing any of the capabilities you've come to expect from Hewlett-Packard.

Assuming that the new HP IIP's \$1,500 list price will shrink to a street price of about \$1,000 (or about \$1,200 with the bottom paper tray most users will opt to buy), dot matrix printers are going to be squeezed into a rather narrow price range.

That's good news for the buyer, because high-end 24-pin dot matrix models are already lowering their prices to remain competitive. Street prices for these machines run from about \$500 to \$1,500. At the low end, 9-pin dot matrix printers can't get much cheaper than \$150 to \$200 (the Epson LX-810 has a street price of around \$175), so companies are piling on features and upgrading construction to attract customers.

#### IT'S ALL IN THE PAPER HANDLING

Undoubtedly you've wondered whether low-end lasers will spell doomsday for dot matrix printers altogether. Well, don't

start digging the grave just yet: dot matrix printers can still pummel lasers in many arenas. Indeed, dot matrix printers can handle multipart forms with ease and fussy labels without a meltdown. Those with color options make color printing affordable, and wide-carriage models handle monstrous paper up to 16 inches wide. Try that with a laser.

So what's your buying strategy for 1989? If you need a printer with one of the matrix-only functions listed above, or if your work is in a heavy-volume environment where speed is a priority, you may still want to buy a high-end 24-pin workhorse. If not, skip straight to a low-end laser and buy one of the sturdy new low-end 9-pin models to handle your forms, quick draft printing, and other nonlaser jobs. The combined price of the two printers shouldn't be more than the price of one laser just a year ago.

The dot matrix sections—monochrome and color—include any printer whose speed can be measured in characters per second. That means you'll find 9-pins, 24-pins, and ink jets here. As you read the reviews in this section, you'll notice a few other new developments. Whereas sophisticated paper handling used to be an extra on dot matrix models, nowadays even low-end 9-pin models have to include it to remain competitive. Many machines have "zero tear-off"—the printer advances the paper so that you can remove finished output, then backs it up so that you can start printing at the top of the page without losing a single sheet. And paper parking allows you to print on single sheets while loaded fanfold paper is retracted; press one button and the printer will lock the fanfold back into place.

#### HIGHER IQ

This year, companies don't stop at paper handling when they try to put together a tempting package. Check out models with multiple paper paths—front, back, top, bottom—to see if they can make your life any easier. Control panels are becoming better conversationalists, with intelligent LCD windows that flash messages in English rather than mumbo-jumbo code. Even front panels with lights or buttons are becoming more straightforward. Printer IQ is rising in more ways than one; some printers can spit out status sheets detailing their current emulation or print settings to eliminate guesswork.

Output quality continues to make progress, but this year's samples still aren't going to knock you off your feet. The day when we'll look at a 24-pin dot matrix printout and guess that it came from a laser is still far off. Characters are looking darker and sharper than before, but it's not uncommon to see horizontal lines running across the scanned photo in the PC Labs test. For your perusal, we've included samples of the halftone image in our guides to monochrome dot matrix printers and color dot matrix printers, not because we think you should print scanned-in photos with dot matrix machines, but to make it easier for you to see how different printers handle graphics.

Some of the best black-and-white output comes from dot matrix printers with color options, so don't forget to give them a look-see. You'll find this group in our section on color dot matrix printers, and our Printer Guide will show you output from PC Labs' color test. Although these printers are functionally identical to their noncolor cousins, we've set them apart for the sake of comparison.

Dot matrix printers may be improving, but we never said they were perfect. Noise levels are still headache-inducing on many machines. But at least we'll have something new to write about dot matrix printers next year, we hope.

## AEG Olympia NP 80-24 AEG Olympia NP 136-24

by Henry Fersko-Weiss

Here's a pair of printers with a healthy number of features and distinctive performance—not a bad combination. The AEG Olympia NP 80-24 and NP 136-24 produce excellent 24-pin text and graphics. They boast an exceptional front-panel arrangement of buttons for controlling almost every function. The one-line LCD display for function choices and messages is quite intelligent. Priced at \$599 for the narrow-carriage NP 80-24 and \$799 for the wide-carriage NP 136-24, AEG's offerings represent a very good value.

The NP 80-24 won't hog your desk. The front of the printer is cut back to form something of a step shape. The control panel stretches across what would be the bottom stair tread—a convenient location for the six membrane buttons that command the NP 80-24. I found the NP 80-24's buttons responsive, but I had to press

## AEG Olympia NP 136-24

## Fonts &amp; Features

## IBM Proprinter X24

	Bold	Italic	Sub-Super	Underline
10 cpi	■	■	■	■
12 cpi	■	■	■	■
Compressed	■	■	■	■
Proportional	■	■	■	■

## Epson LQ-1500

	Bold	Italic	Sub-Super	Underline
10 cpi	■	■	■	■
12 cpi	■	■	■	■
Compressed	■	■	■	■
Proportional	■	■	■	■

very firmly on the NP 136-24's to get a reaction.

The button you'll use most often is Menu. Press it as you power up the printer and you get access to configuration choices. They include the emulation—a choice between Epson LQ and IBM Proprinter—the character set, baud rate, download buffer, and alignment, among others.

If you press the Menu button while the printer is on, you can cycle through font selections, pitch, left and right margins, page length, print direction (bidirectional or unidirectional), and so on. In fact, you can set up two alternate menus with defaults for all of these format choices. You activate one or the other menu by choosing it in menu mode and then turning the power off and on again. Having the ability to preset two format configurations makes for efficient operation.

The selections you make with the buttons are displayed in a 16-character LCD window. The LCD display is also used to indicate errors, as are the four LED lights. The rather extensive control panel makes the printer very easy to use. And you don't have to worry about changing DIP switch settings.

The tractor feeder on the printer pushes the paper around the roller. You can print on single sheets without removing the continuous paper by using paper parking. Park the paper by simply pulling once on the paper bail lever, on the top right side of the printer. A single-sheet guide fits right over the tractor. Multi-part forms and even thick

card-stock paper roll through smoothly. An optional single- and dual-sheet feeder can handle up to 150 pages.

The print quality of the NP 80-24 is excellent. All the fonts—there are five of them in addition to draft—have a true letter-quality appearance. They are clear, sharply etched, and show little sign of the dots that compose them. In addition, you can print the fonts in any of 12 character-per-inch measures. Three of these are for different forms of proportional spacing. Such flexibility in text appearance is a definite advantage.

The type styles vary from a more ornate Gothic to a modern-looking Optimo. The selection was more than enough to find a couple of fonts I really liked. AEG Olympia also offers a \$59 font cartridge, which includes Script, Orator, and Square. Both printers also come with a full complement of printing and formatting enhancements, from bold and underlining to variable line height, vertical tab, and double-wide print.

The 360- by 180-dpi graphics are as good as the text—perhaps better. The scanned photo was printed very faithfully,

with the subtle shadings of the face revealed. The gray scale was also very well printed, with little filling in on the fine cross-hatchings.

You get 24K of memory with both the NP 80-24 and the NP 136-24. This is a good size for a print buffer, and you can add in another 32K for just \$29. If you do a lot of graphics printing, you'll want the full 56K of memory.

For text, the printer operated at an acceptable 115 characters per second in draft mode and at 52 cps in LQ mode. Our graphics image took over 30 seconds in the Epson LQ-1500 emulation and almost two and half times that amount in the IBM Proprinter emulation. The NP 136-24 operated a little faster on all tests.

In the Olympia NP 80-24 and NP 136-24, AEG has put together the best of all worlds: top 24-pin functionality, sophisticated output, and reasonable price. As long as speed isn't your top priority, give these two some serious consideration.

## Amstrad DMP3000

by Susan L. Hayes

The DMP3000 from Amstrad is the dot matrix version of the little printer that could. At just 9.2 pounds, this black-and-white impact printer weighs in light and even sells for a lightweight price—\$300, including cable. As long as the tasks you'll need it to perform are also lightweight, this one is worth consideration.

This 9-pin printer has a parallel Centronics 36-pin connector and is so small and compact it will fit almost anywhere. Paper pulls through the tractor smoothly and easily in an upward "L" fashion and can be set so that printing begins at the very top of the page.

The DMP3000 has the ability to adjust for varying paper thicknesses at the touch of a knob; it printed without problems on card stock. It had a bit more difficulty with the multipart form test in draft mode, where it tended to jam, but in NLQ mode the printer ran more smoothly.

Amstrad hasn't loaded this printer up with extra features, but all the basics are there. There are the six main typefaces: Pica, Elite, proportional, condensed, NLQ, and NLQ proportional, as well as all the basic enhancements.

The DMP3000 produces excellent quality text and decent graphics, but be warned that it takes a while. Amstrad claims a draft speed of 160 characters per



**AEG OLYMPIA NP 80-24**  
**AEG OLYMPIA NP 136-24**

**PC** **FACT FILE**  
**EDITOR'S CHOICE**

AEG Olympia Corp., 3140 Route 22, Somerville, NJ 08876; (201) 231-6300.  
List Price: NP 80-24, \$599; NP 136-24, \$799.  
Dimensions (HWD): NP 80-24, 12 x 22.5 x 4 in.; NP 136-24, 13.75 x 25 x 5 in.  
Weight: NP 80-24, 17.6 lbs.; NP 136-24, 22 lbs.  
Emulations: Epson LQ, IBM Proprinter  
In Short: The AEG Olympia NP 80-24 and NP 136-24 offer excellent 24-pin print quality, a very nice control panel with a one-line LCD display, and a compact design. They are well worth their reasonable prices.

CIRCLE #17 ON READER SERVICE CARD

## MONOCHROME DOT MATRIX

second; our tests turned up a rate of around 60 cps, and in NLQ mode an agonizing 19 cps, compared with Amstrad's claim of 40 cps. The best graphics samples were produced when emulating the Epson FX-80 and the IBM Proprinter (9-pin) and took 110 and 92 seconds, respectively. And don't expect to pursue tasks that require concentration while you wait. After listening to a few documents being printed at a deafening 82 decibels, your nerves will probably be shot.

Although the DMP3000 was not 100-percent compatible with the high-order IBM character set in PC Labs tests, it came very close. Amstrad also offers several DIP-switch-selectable Epson FX and IBM character sets. The DIP switches are used to implement a slashed zero as well.

You can't miss the control panel located on the top right, with its LED indicators and raised buttons for operating the separate form- and line-feed commands. Installation, however, is less obvious. Inserting the rather fragile fabric spool ribbon is as frustrating as trying to solve Rubik's cube (and just as satisfying when you do accomplish it). Don't even bother looking at Amstrad's manual—it gives you excessive information at the cost of relevant material about the basic capabilities of the printer. While a call to Amstrad's technical support line might be helpful, expect a busy signal.

Buying a low-end dot matrix printer is a matter of priorities and sacrifices. If your needs are limited, you won't have to give up much with Amstrad's DMP3000—ex-

## AMSTRAD DMP3000



## FACT FILE

Amstrad, 1915 Westridge Dr., Irving, TX 75038.  
(214) 518-0666

List Price: \$300

Dimensions (HWD): 3.75 x 15.75 x 9 in.

Weight: 9.2 lbs.

Emulations: Epson FX-80, IBM Proprinter, IBM Graphics Printer

In Short: If you don't have a need for speed or fancy fonts and features but do have to watch your wallet, this unobtrusive 9-pin printer is worthy of consideration.

CIRCLE 897 ON READER SERVICE CARD

this one simply isn't going to make it.

Once you have the printer out of the box, you might think you're ready to go. First, however, you have to insert the harmonica cartridge—although the fabric ribbon doesn't look like it's going to hold up long enough to print the first document. (Amstrad ought to stick in a plastic glove.) The cartridge snaps into place without too much aggravation, but it is fortunate you don't have to depend on the documentation for guidance. The manual is full of what could be extremely helpful photographs of properly assembled printer parts; it's a shame they are all so dark they're useless.

Then you've got to attach the tractor and feed the paper through. No problem? Yeah, right. Here's where the LQ 3500 might make you scurry off in search of a laser printer—or even an electric typewriter. The external tractor is indeed external and sits high above the platen. This setup allows you to start printing at the edge of a page, but in order to get to the edge of one page you first have to scroll up a full page. Thus, as long as you use tractor paper, you'll be forever sacrificing one page to arrive at the edge of another.

To load the paper you must turn the LQ 3500 around so its back is facing you; this could pose a problem if the real estate you've assigned to it doesn't offer much maneuverability. And no matter how carefully and precisely I adjusted the paper from the rear U, the paper jammed.

Attaching Amstrad's paper feeder to orchestrate paper flow doesn't seem to help

cept a bit of time and quiet. This printer offers very good quality text output and acceptable graphics at a nice price—you just have to decide if it's worth the wait.

## Amstrad LQ 3500

by Susan L. Hayes

Amstrad, a long-established participant in the mainframe world, is a relative newcomer to the PC marketplace and appears to have a few things to learn. With the LQ 3500, a \$500 24-pin dot matrix printer, Amstrad is suffering from delusions of grandeur.

It looks harmless enough—attractive even. The raised-button control panel is located on the right front with LED indicators and separate controls for form and line feed. At 13 pounds with a size of 4 by 17.5 by 16 inches (HWD), it hardly seems intimidating, but whoever said appearances can be deceiving might have been talking about the LQ 3500.

Admittedly, Amstrad's letter-quality printer does produce very good text output with excellent letter-quality resolution, but for anyone who wants instant gratification,

## Amstrad DMP3000

## Fonts &amp; Features

## Epson FX

	Bold	Italic	Sub-Header	Underline
10 cpi	■	■	■	■
12 cpi	■	■	■	■
Compressed	■	■	■	■
Proportional	■	■	■	■

## IBM Proprinter 9-pin

	Bold	Italic	Sub-Header	Underline
10 cpi	■	■	■	■
12 cpi	■	■	■	■
Compressed	■	■	■	■
Proportional	■	■	■	■

## Amstrad LQ 3500

## Fonts &amp; Features

## Epson FX

	Bold	Italic	Sub-Header	Underline
10 cpi	■	■	■	■
12 cpi	■	■	■	■
Compressed	■	■	■	■
Proportional	■	■	■	■

## IBM Proprinter X24

	Bold	Italic	Sub-Header	Underline
10 cpi	■	■	■	■
12 cpi	■	■	■	■
Compressed	■	■	■	■
Proportional	■	■	■	■

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192 Characters per second  
High-throughput design

#### Unbeatable Value

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Under \$500.00 retail

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Command Vue™ LCD Control Panel  
4 Programmable macros

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Programmable top-of-form  
Sheet feed capabilities  
Paper parking  
Bottom, top and rear feed

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Plain English commands  
Quick Menu  
Built-in Help

#### Color-on-Command

User installable 7-color option



# The GSX-140's Intelligence Is Only Half The Story.

Never before has a 24-wire printer offered so much intelligence. And never before has so much intelligence performed so well. Especially for a suggested retail price of under \$500.00.

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It puts four programmable user formats at your fingertips, as well as a Quick Menu to let you scan and access all selected functions. It even offers an on-line help system if needed.

As for paper handling, you get programmable top-of-form, versatile sheet feed and paper parking capabilities. The

convertible push-pull tractor allows you to put any kind of form into its bottom, top and rear feeds, from payroll checks to labels. Making the GSX-140 the only printer you'll ever need.

A myriad of options are available including Color-On-Command™ which you can easily install yourself for under \$60.00. You can also get a semi-automatic or automatic sheet feed option.

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 **CITIZEN™**

# PRINTERS

## MONOCHROME DOT MATRIX

### AMSTRAD LQ 3500



### FACT FILE



Amstrad, 1915 Westridge Dr., Irving, TX 75038;

(214) 518-0668

List Price: \$500

Dimensions (HWD): 4 x 17.5 x 16 in.

Weight: 12.9 lbs

Emulations: Epson FX-80, Epson LQ 1500, IBM

Proprinter, IBM Graphics Printer

In Short: Amstrad tries; it just needs to try a little

harder. The LQ 3500 produces good output, but

the hassles of getting it there make you question

whether or not it's worth it

CIRCLE 606 ON READER SERVICE CARD

matters much. If you tend to use card stock and multipart forms frequently, you might have better luck. They jammed a bit, too, just not quite as badly. Amstrad's letter-quality printer doesn't even put you out of your misery quickly. Under the Epson FX emulation, it printed our graphics test in a painfully slow 95 seconds. Having to contend with the 82-decibel racket made the whole process even more interminable. In our graphics tests the samples produced were passable, although they tended to elongate the image. The best of the lot was the emulation of the Epson LQ-1500, which turned out quite well.

Among standard typefaces, including Pica, Elite, condensed, and proportional, the letter-quality output stood out as top-notch and would be hard to distinguish from an IBM Selectric typewriter. The usual selection of enhancements can be applied. However, if it absolutely positively has to be there overnight, with a letter-quality speed of 32 cps, it would be advisable to start printing a few days before in order to get it done.

You can eventually get satisfactory results from Amstrad's LQ 3500, but it doesn't offer much that you can't get—with a lot fewer headaches—from dozens of other dot matrix printers. This printer's few pluses are outweighed by too many minuses. Your five hundred bucks, hard-earned or not, is better off spent somewhere else.

## AT&T 570

by Edward L. Perratore

If you're searching for a reliable, middle-of-the-road dot matrix model for text and light graphics applications, take a look at the \$695 AT&T 570.

The AT&T 570 is one of a family of four 9-pin impact dot matrix models. Like its wide-carriage sibling, the 571 (not reviewed here), the 570 supports the Centronics-type parallel interface and emulates both the IBM Proprinter and the Epson FX 86e/286e. The next-higher series from the company is the 24-pin 580 series; from that group, you'll find the wide-carriage AT&T 583 reviewed in the color

## PAPER FOR DOT MATRIX PRINTERS

by Alfred Pood

There was a time when choosing paper for your dot matrix printer was simple: you took either the 9.5-by-11 white or the 14.87-by-11 green-bar. The perforations on the letter-size sheets left little tufts of paper fuzz along the edge of the page—an obvious signal that your sincere personal correspondence had been run off on a tractor-fed machine. And the large sheets were great for financial reports, except that they wouldn't fit into letter-size file folders.

All that has changed. Open any computer supply catalog and you'll be inundated with choices. And variety in size is just the start. For example, letter-size paper is now available with perforations that all but disappear when you tear off the edges.

Other innovations affect color and texture. Choose from white, gray, ivory, and other shades. Take a classic laid bond, or even a 25-percent-cotton bond, for important jobs. Many suppliers can even print your letterhead on the sheets for a customized look.

Or maybe you prefer something

with a bit more zip. You can get tractor-fed paper in a wide range of colors, such as green, pink, yellow, red, or blue, either in bright or pastel shades. Even traditional green-bar printout paper is getting prettier: choose from green-bar, blue-bar, or two-tone. And Immac of Santa Clara, California ((800) 547-5444) has added a new twist: heringbone patterned bars. Developed in England, the paper is supposed to be easier to read and comes in your choice of blue, green, or amber bars.

Your color selection extends beyond paper. How about mailing labels? Not only do they come in a dizzying array of shapes and sizes, they're also available in a variety of solid and pastel colors. You can even buy clear plastic labels that will let the color of the paper underneath show through.

And what about paper size? One of my personal favorites is 14.87-by-8.5 paper. It comes in green-bar (among other choices) and gives you the full width of regular financial paper, but by changing to eight lines per inch you get the same amount of data on a page that

fits in a legal folder (or a letter folder with one edge folded over). It's much easier to handle than 14.87-by-11 paper.

Many suppliers also offer "triple-perf" paper. This is 14.87-by-11 paper that has a perforation on the right. On tearing the page apart, you get a standard 8.5-by-11 letter-size sheet, and a 5.37-by-11 section that can be used for memos.

Don't think that having a tractor-fed printer means that you can print only on conventional paper and labels. You can find tractor-feed standard index cards in different sizes, including those accepted by the U.S. Postal Service for use as postcards. Rolodex cards also come in tractor-fed sheets, so you can print out a client list or a product file for quick reference.

So while it may seem that you face a bewildering number of choices when selecting what to feed your favorite printer, at least you can be secure in the knowledge that you can let your imagination run free, and you'll still be able to find just the right paper to print out the results. ■



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CIRCLE 161 ON READER SERVICE CARD

# If you want better word processing, don't settle for Perfect.



## REPORT TO THE FIELD



### Bliss enough

After *Footnote* earnings and going, Jim Darling becomes V.P. Design for *After* Design and Design wear. King Victoria moves from *Peris* to marketing in Miami. Joan MacArthur and Lisa Doss become account supervisor and media planner, respectively. *Time* 2

### Sales per region

Across the board 4 broke the South once again led sales in FY '88. With the continuing pump crust these figures should maintain, if not improve. *Time* 3's important sale to let the other areas such as Nordens and Midwest fall.

Style	Event	Agent	Owner	Comment
Shooting of	Westminster	Talbot	Talbot	Traverse up
Shooting of	Richmond	Laurel	Laurel	Traverse up
Trident	Trident	M.A. Sound	M.A. Sound	Special sponsor
Phone	\$100-\$150	\$50-\$100	\$100-\$200	\$200-\$500

### Young professionals use *After* Walker to connect.

Even, young professional women will no longer be using *After* alone simply to climb the corporate ladder. They're using them to get done.

This fall we're introducing the *After* Walker -- a shoe that gives you a few steps farther than the new accepted but uncomfortable women shoes have been wearing so and from work.

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*After* Walker designed by *Pro* from

### SALES FORECAST FOR 1988

	1st quarter	2nd quarter	3rd quarter	4th quarter
Dress	95,000	97,000	100,000	90,000
Coat	40,000	42,000	45,000	38,000
Coat	120,000	125,000	130,000	115,000
Suits	175,000	180,000	185,000	170,000
Totals:	\$360,000	\$344,000	\$360,000	\$313,000

Source: *McGraw-Hill*, 4/2/88

Not shown: *After* Walker for *After* Design and Design wear.

On 4/2/88, 1:15 PM

Figure for *After* Walker and *After* Walker is calculated separately and should not be used before they fall with prices.

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Which requires fewer keystrokes?	Microsoft Word 5.0	WordPerfect 5.0
Copy Block	4	7
Delete Line	2	4
Indent Word	2	5
Change Font and Size	6	9
Add Footer	1	7
Box Paragraph	5	12
Total	20	44

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Software Digest recently chose the best overall advanced word processor on the market. Who won? In a word, Word.

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# PRINTERS MONOCHROME DOT MATRIX

dot matrix section in this issue.

For the \$70's price you get a sleek, unpretentious design, an efficient internal tractor feed with a variety of feed options, and a straightforward setup routine accomplished through the printer's control panel.

The control panel sports four membrane buttons that control print quality, on-line operation, form feeds, and line feeds. Lights indicate power-on, on-line, alarm, and print quality; for the latter, the indicator remains off during draft-mode printing.

No special setup is necessary for most printing. Once you've attached your cabling, paper separator, and paper cover, you'll find four ways to insert paper: through the bottom, with a push/pull tractor, from the rear, or straight through from the top. Each allows printing with no tear-off. The 570 also offers a limited form of paper parking, though you won't see it mentioned in the generally comprehensive documentation.

The AT&T 570 offers both letter-quality (LQ) and near-letter-quality (NLQ) type; you can switch between the two via the setup mode. Curiously, only LQ mode offers standard Courier 10. Draft as well as NLQ print are in a sans serif block type that, alas, is also currently undocumented. (AT&T plans to include both this feature and the paper parking in the manual's next printing.)

Not to worry, though. Type is crisp in both the LQ and NLQ settings, notwithstanding the disappointing 28.3-character-per-second rate of LQ printing. Except for shadow and red/black ribbon printing, all

AT&T 570



## FACT FILE

AT&T Information Systems, 100 Southgate Pkwy., Morristown, NJ 07960; (800) 247-1212. List Price: \$695.

Dimensions (HWD): 5 2 x 17 x 15 in.

Weight: 21 lbs.

Emulations: Epson FX, IBM Proprinter

In Short: This midrange 9-pin offers good speed, attractive quality print, and unpretentious design. Especially impressive is the paper handling: four paper-feed options as well as forms tear-off and paper parking. The AT&T 570 also comes in a wide-carriage model.

CIRCLE 608 ON READER SERVICE CARD

printing enhancements, including Courier italic (Epson mode only), underline, double strike, and super/subscripts, are available. As for formatting enhancements, they're all there, too—although centering and right justification can be achieved only through your application.

On our tests, the text-printing speed was an average 124 cps (compared with the 250 cps claimed) in draft mode. The 570 handled our graphics test in 52 seconds in Proprinter (9-pin) emulation, producing acceptable if uninspiring output.

If Courier alone doesn't fit into your plans, you can purchase from the company as many as five font cartridges for the 570. Priced at \$75 each, they offer Letter Gothic, Light Italic, OCR A, OCR B, and Bold Proportional. Other add-on products include a single-bin cut-sheet feeder (100-sheet capacity), sold for \$330, and a \$225 extension module for the single-bin feeder that converts the 570 to dual-bin.

While the AT&T 570 isn't for everyone, this is no poorly designed model from a nickel-and-dime company. The 570 does relatively few of the things that raise a dot matrix to high-end status, but it does its job well enough to merit a look.

## Blue Chip M200/NLQ

by Catherine D. Miller

The \$299 Blue Chip M200/NLQ is Blue Chip International's new low-end printer. Based on older printer technology, this compact 9-pin machine produces reasonable type and graphics. The M200/NLQ is clearly not intended for heavy usage, but it's certainly adequate for someone who needs a low-cost printer with basic functionality.

Setup is fairly simple, even though the printer doesn't include a soft setup procedure. Eight slide switches located on the top right of the printer—and conveniently labeled on the removable slide-switch cover—allow you to select basic parameters such as the emulation mode (Epson FX-80 or 9-pin IBM Proprinter), the IBM charac-

### Blue Chip M200/NLQ

#### Fonts & Features

##### IBM Proprinter 9-pin

	Bold	Italic	Sub-Super	Underline
10 cpi	■	■	■	■
12 cpi	■	■	■	■
Compressed	■	■	■	■
Proportional	■	■	■	■

##### Epson FX

	Bold	Italic	Sub-Super	Underline
10 cpi	■	■	■	■
12 cpi	■	■	■	■
Compressed	■	■	■	■
Proportional	■	■	■	■

AT&T 570

## Fonts & Features

##### IBM Proprinter 9-pin

	Bold	Italic	Sub-Super	Underline
10 cpi	■	■	■	■
12 cpi	■	■	■	■
Compressed	■	■	■	■
Proportional	■	■	■	■

##### Epson FX

	Bold	Italic	Sub-Super	Underline
10 cpi	■	■	■	■
12 cpi	■	■	■	■
Compressed	■	■	■	■
Proportional	■	■	■	■

ter set, line spacing, form length, and slashed zero. Eight DIP switches, located in the rear of the printer, control the international character set, buzzer on/off, and the ability to download characters.

The control panel, located directly below the bank of slide switches, has On-Line, NLQ, Form Feed, and Line Feed buttons, as well as Power, Paper Out, Ready, and NLQ lights. A switch-selecting mode, activated by pressing the On-Line and Form Feed buttons at the same time, allows you to select several print styles without entering control codes. By pressing the On-Line key up to six times, you can choose emphasized, double strike, condensed, and Elite settings, as well as

draft Pica and NLQ print modes.

The paper-handling capabilities are limited but adequate for routine usage. Fanfold paper can be fed from the rear only; however, there is no route to load single sheets. When the printer is nearly out of paper, a paper-end detector sounds the buzzer and lights the Paper Out indicator. The Form Feed and Line Feed buttons provide control over paper position. Not surprisingly, the printer couldn't handle our four-part carbon form or our cardboard stock.

In both Proprietary and Epson emulation modes, the printer produced muddy-looking, overly saturated graphics on the PC Labs graphics emulation tests. In Epson emulation mode, a 6 was thrown into the upper-left-hand corner, probably the result of an uninterpreted control code.

In our speed tests, the M200/NLQ turned in unacceptably low scores: with a claimed speed of 135 characters per second in draft mode, we expected rates around 70 and 35 for draft and letter-quality, respectively. Instead, the M200/NLQ scored 49 cps in draft mode and 17.8 cps in NLQ mode while emulating the Epson FX-80; it scored 44 cps draft and 17.8 cps NLQ in Proprietary emulation mode. It had no trouble with the extended ASCII character set while emulating the Proprietary, indicating a good degree of IBM compatibility.

Like the graphics, the type has a tendency to be a bit fuzzy and very saturated. But my biggest complaint about the M200/NLQ's print quality is that the type produced by the multistrike mylar ribbon tends to smear excessively. The printer doesn't support any type of ribbon other than the one tested.

The Blue Chip M200/NLQ is easy to set up and use but offers limited capabilities, as one might expect from a low-end printer. I encountered no problems in using the printer, and though it performed adequately on our emulation tests, it is very slow and its type lacks sharpness. At a list price of \$299, you get about what you pay for.

## Citizen GSX-140

by Bruce Brown

The brand new Citizen GSX-140 is clear evidence of the high quality and advanced feature set that you can get today in a relatively low-cost 24-pin dot matrix printer. This \$499 machine has top-quality NLQ type, reasonable speed, and a long list of features and functions that make it powerful, flexible, and easier to use than many earlier printers.

Weighing in at just 11.5 pounds, the Citizen GSX will soon have a color option,

priced at \$59. Our test unit had the standard Centronics parallel interface port, but you can buy a 25-pin 9,600-bit-per-second serial interface option for \$49. The GSX-140 uses 2-million-character-rated harmonica-style ribbons that are no fuss at all to install. If you do go for the pending color option, four-color ribbons cost a hefty \$25.99 each.

The GSX-140 can be set to emulate the Epson LQ printer series or the IBM Proprietary X24. The 24-pin Epson settings caused no problems, and neither did the Proprietary emulation.

The biggest news about the GSX-140 is the superb quality of its NLQ output. I used this machine's print samples as examples of top-quality 24-pin output when other reviewers wanted something with which to compare their own printers' samples. With a maximum resolution of 360 by 360 dpi and a firmly held head, the GSX-140 did a fine job on the graphics printing tests. Dot matrix type quality will probably advance in the future, but right now this is about as good as you'll get.

There are four LQ resident fonts: LQ Roman, LQ Sans Serif, LQ Courier, and LQ Prestige. There's no provision for extra fonts via cartridges or cards.

The GSX-140 isn't a superfast printer, but it's reasonable for its price, especially when the output looks so good. On the PC Labs speed test, the GSX-140 scored 100 characters per second in draft mode, 46 cps in NLQ mode, and 53 cps with NLQ proportional type. It handled our graphics test at a good clip, delivering the output in 69

## Citizen GSX-140 Fonts & Features

### IBM Proprietary X24

	Bold	Italic	Subscript	Underline
10 opt				
12 opt				
Compressed				
Proportional				

### Epson LQ-1500

	Bold	Italic	Subscript	Underline
10 opt				
12 opt				
Compressed				
Proportional				

### BLUE CHIP M200/NLQ



### FACT FILE

Blue Chip International, P.O. Box 40910, Mesa, AZ 85274, (602) 731-6980.

List Price: \$299

Dimensions (HWD): 4.4 x 15.5 x 10.75 in.

Weight: 10.56 lbs.

Emulations: Epson FX-80, IBM Proprietary (9-pin)

In Short: An easy-to-use, low-end 9-pin printer with basic paper handling and emulations, the Blue Chip M200/NLQ offered no surprises.

CIRCLE 610 ON READER SERVICE CARD

## Seagate's ST157 Family

### THE FINE ART OF DISC DRIVES



Oil painting by  
Francis Livingston  
San Anselmo, California

As the storage and retrieval device for valuable information, a disc drive plays a critical role in a personal computer's overall operation. Building hard disc drives that deliver both high performance and high reliability requires the same degree of precision employed by skilled artists.

This precision is reflected in every Seagate ST157 family drive. Using our own stepper motor processes, each drive is auto-tuned for optimum performance every time the drive is powered up.

This 21-49 megabyte 3.5" drive family is a skillful blend of performance and reliability. With access times of 28 msec, these drives feature an MTBF of 70,000 hours, and are available in SCSI, ST412 and AT<sup>™</sup> interfaces.

Like the artist who spends years perfecting his craft, Seagate has spent the past decade mastering the fine art of disc drives. For more information on our palette of high quality storage solutions, contact your authorized Seagate distributor, or call Seagate directly at 800-468-DISC, or 408-438-6550.

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seconds in Printhead mode.

As with many of the latest printers, the GSX-140 has no DIP switches. You can control all printer feature and function settings via a control panel with six buttons, a two-line eight-character LCD display, and three LED indicator lights, selecting from a wide range of settings. The control panel does so much that you'll want to spend a little time getting used to it, although there

are also Quick Menus for feature-specific settings such as fonts and pitches. In addition, you can save up to four macros, user-defined setting combinations that can be easily recalled.

A new and different feature on the GSX-140 is software that comes standard with the printer. This software includes

two programs on a 5.25-inch 360K floppy disk: GSXSET, a utility program that helps you set printer features the way you want them without having to learn printer commands; and GSXREF, a complete command reference for those who do want to make changes via specific commands. With this software, you never have to touch the printer control panel to select printer settings—a classy touch.

## THE PRINTRONIX P3040: A Line at a Time

by M. David Stone

Line printers have a long history of reliably churning out page after page of output with hardly a rest. However, line-printer manufacturers have largely ignored the microcomputer market on the grounds that most PC users don't need either the line printer's amount of output or its level of reliability to justify its cost. In perfect symmetry, PC users have largely ignored line printers for much the same reasons. Yet some PC applications actually may be better served by a line printer.

Enter the Printronix P3040, a \$4,750 line printer that cranked out a speed of 396 lines per minute on our tests. Printronix has decided that the PC market can no longer be ignored. To prove it, the company has put an IBM Graphics Printer emulation in the P3040 along with the printer's native P-series mode.

If you think \$4,750 is a lot for a printer that, after all, produces dot matrix output, you're right. And if you get the soundproof stand for \$650 and add the \$995 graphics option for printing bar codes, the total jumps to \$6,395. But don't write off the P3040 before you take a close look at this beast.

A standard PC dot matrix printer prints one character at a time, moves the print head, and prints the next character. If there are fewer characters on a given line, the printer will spend less time on the line. That's why PC Labs reports the speed in cps.

Line printers don't work that way. (For that matter, neither do lasers.) Line printers actually bang out the entire line at once, spending the same amount of time on a line with one character as on a line with 132 characters. In short, a cps rating doesn't mean very much for a line printer. Nevertheless,

looking at the cps rating may help put the lpm rating in perspective.

The PC Labs speed test automatically gives character-per-second (cps), line-per-minute (lpm), and page-per-minute (ppm) ratings. For the P3040, 396 lpm is equivalent to 275 cps. This is already faster than most character printers manage, but keep in mind that the test uses a letter-size page, while the

readable. Draft mode is darker, solid, and still more readable, though the characters are a little fuzzy around the edges. NLQ mode is darker still, with reasonably crisp characters. You may not want to read a lot of high-speed draft output in one sitting, but you won't mind the draft mode or NLQ mode at all. The dot matrix density for each character ranges from 7 by 9 in

### Printronix P3040

\$6,395 wide-carriage line printer



P3040 has a wide carriage. If the text used a 132-character line, with an average of, say, 100 characters per line, the P3040 would clock in at a hefty 660 characters per second.

In some ways, a comparison with page-per-minute ratings makes more sense—first, because for any given number of lines per page, the fixed amount of time for printing each line really does translate to a fixed speed for pages per minute; and second, because the speed is well into laser territory.

In high-speed draft, the P3040's 396-lpm speed translates to a noteworthy 9.5 ppm. Standard draft comes out at 293 lpm, or 7 ppm. Letter-quality mode comes out to a still-respectable 183 lpm, or close to 4.5 ppm.

Happily, the P3040 scores well on print quality as well as on speed. High-speed draft shows the telltale almost-individual dots but is dark and highly

NLQ mode to 5 by 5 in high-speed mode. But the characters are far more solid than the numbers indicate because individual dots are larger than in most dot matrix printers.

On the PC Labs emulation test, the P3040 handled the IBM Graphics emulation as advertised. And it took only 12 seconds to print our scanned photo test. Dark areas were solidly filled in. Alas, so were many of the more-intricate patterns. The scanned photo showed a distinctly posterized effect, though that is partly a result of the IBM Graphics emulation.

As you might expect in a high-speed line printer, paper feed is limited to a bottom slot with a vertical path. As tested, the printer came with its own soundproof printer stand. Not surprisingly, the P3040 handled the heavy-weight paper and multipart forms with ease.

## PRINTERS MONOCHROME DOT MATRIX

### CITIZEN GSX-140



#### FACT FILE

Citizen America Corp., 2401 Colorado Ave., #190, Santa Monica, CA 90404; (213) 453-0514

List Price: \$499; color option, \$59.

Dimensions: 13.5 x 16.75 x 6.75 in.

Weight: 11.5 lbs.

Emulations: Epson LQ, IBM Proprinter X24

**In Short:** The Citizen GSX-140 is a terrific narrow-carriage 24-pin dot matrix printer. A bit loud, but otherwise it's a winning combination of speed, full feature and function setting via control-panel menus and separate software, rear and bottom feed with a dual-function tractor, and, best of all, much-better-than-average NLQ print quality.

CIRCLE #11 ON READER SERVICE CARD

lopes up to 10 inches wide and rated to 27 pounds. The maximum multipart-form thickness is 0.2 mm.; I had no problems printing four-part forms both with the rear and bottom feeds. To get card-stock paper to work acceptably, I had to use the bottom feed. The GSX-140's one-button paper feeding operated quite smoothly.

The standard buffer size is 8K, but a \$69 32K memory upgrade option is available and was tested with this unit. This is the only GSX-140 option that is not user-installable.

Even though the GSX-140 is fairly light, its case feels solid. Unexpectedly, it scored 82 decibels on the PC Labs noise level test, making it one of the louder dot matrix printers tested this year.

Other than the slightly false note on the sound test, this is an incredibly likable printer. It produces great type and good graphics, has intelligent and convenient function control, includes a bottom feed for thick stock and multipart forms, and moves along at an acceptable rate. This one's a keeper.

## C. Itoh 5000

by John R. Quain

Speed may not be the most desirable quality in all things, but in printers it has always been something of a cause célèbre. If you're one of the character-per-second cheerleaders, the \$1,995 C. Itoh 5000 will not disappoint you. And speed isn't the only feature that soothes the sting of the 5000's rather steep price: It also offers multiuser capabilities, an easy-to-use front panel, and solid construction.

Targeted at LAN users and those with printer-sharing needs, this 18-pin wide-carriage machine delivers five different print modes: draft, memo (a dense, but fuzzy print), near letter quality, letter quality, and a high-speed draft mode.

In high-speed draft, the 5000 kicked out copy at 258 characters per second, making it one of the faster dot matrix printers we tested this year. At 239 cps, draft printing came in just a tad behind the high-speed setting but resulted in much clearer characters. Although the high-speed draft offers a few more characters per second, it isn't worth the sacrifice in print quality.

The difference in visible quality between letter-quality and near-letter-quality modes is negligible, with the latter delivering clean, solid type at a respectable 73 cps. As is generally the case with such output, however, a close inspection betrays its dot matrix origins.

The 5000 offers proportional, Elite, Courier, and sans serif faces, all of which can be selected from the control panel.

### C. Itoh 5000

#### Fonts & Features

##### IBM Proprinter S-pin

	Bold	Italic	Sub-Header	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

##### Epson FX

	Bold	Italic	Sub-Header	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

The GSX-140 also distinguishes itself with its paper-handling methods. The GSX sports pressure feed for single sheets and an internal push tractor for continuous-form paper. You can reposition the tractor as a pull tractor unit and, using a bottom-feed paper slot, pull paper vertically through the unit—especially good for multipart forms and heavy stock.

The GSX can handle paper and enve-

As you might expect also, this is a hefty unit. The printer itself measures about 20.75 inches deep by 24 inches wide by 10.5 inches high. Add the printer stand, and the height goes to 35 inches.

One other important issue is noise level. While this is an inherently loud printer, the soundproofing is good. We measured 90 decibels with the cover open but only 73 dB with the cover closed—so you can comfortably sit next to the P3040 while it's hard at work.

As with most printers that cost more than a used car, the question with the Printronix is not so much whether the printer is worth the money as whether you need the capability. For most PC users, the answer is still undoubtedly no. However, if you need to print large amounts of wide-carriage output or large numbers of bar codes or other labels, the P3040 may well be worth its price.

#### Printronix P3040

Printronix Inc., 17500 Cartwright Rd., P.O. Box 19559, Irvine CA 92713; (714) 863-1900.

List Price: \$6,395 for printer as tested (including \$4,750 printer, \$650 soundproofed stand, \$995 IGP board for bar code graphics).

Dimensions (HWD): 35 x 24 x 20.75 in. (includes printer stand)

Weight: 70 lbs.

Emulations: IBM Graphics Printer,

Printronix native P-Series mode

**In Short:** The Printronix P3040 line printer has a claimed speed of 400 lines per minute, and a measured speed of 396 lines per minute. If you need to print large amounts of wide-carriage output, labels, or bar codes, this may be your printer of choice.

CIRCLE #18 ON READER SERVICE CARD

# PRINTERS MONOCHROME DOT MATRIX

You can also adjust emulation, form length, line spacing, pitch, print quality, margins, print direction, slashed zero, and the character set, all from the front control panel.

If you're of the press-the-buttons-first school, you'll have no trouble understanding the panel's setup and LCD readouts without succumbing to the documentation. For anyone familiar with printer commands, the panel's 15-character LCD display is self-explanatory and much easier to master than that of, for example, the Panasonic line. And although the documentation is not quite up to snuff yet, it does explain clearly the few inscrutable codes you will find.

The 5000 offers several features for the multiuser environment. In addition to the de rigueur Epson and IBM emulations, the 5000 also can accommodate the DEC user via its serial port (an RS-232 port is also part of the standard setup). The 5000 attempts to capitalize on this by offering the additional convenience of user profiles, which can be customized to three different sets of printer attributes, plus a temporary profile for special print jobs.

Each profile can be set up via your PC or from the printer's control panel by skipping through the LCD menu. You can set

one on IBM emulation at draft quality, another on Epson FX emulation at letter quality, and yet another on memo quality. These profiles can be printed out for reference by pressing a key on the printer.

As with most new products, there are still a few kinks to be worked out on the 5000. The LAN functions should allow users to change the user profiles remotely; however, with the Novell LAN we tested this feature on, we were unable to get the escape sequences to override the control-panel profile settings. The company explained that the feature is so new that codes were not yet included in the documentation. A color option is also forthcoming, according to the company, as are memory-expansion options and additional font cartridges.

Another multiuser feature is the 5000's construction, which was designed with heavy service in mind. According to the company, the 18-wire printhead has an estimated lifetime of 500 million characters and a 1-year warranty. Double tractors hold the paper firmly in place to allow paper-handling features typical of high-end dot matrix printers: bottom or rear feed, paper parking, single-sheet friction feed, and zero tear-off.

For a small office with several different users of varying dexterity, beware ribbon changes; gloves are mandatory (and are included).

Except for the minor glitch while testing the remote management of user profiles, this sleek, new C. Itoh model ran smoothly, making the 5000 a solid, speedy, and easy-to-use contender in the high-end dot matrix class.

## Epson FX-1050

by Bruce Brown

In the printer business, the name Epson is synonymous with "standard." The \$799 Epson FX-1050 is the newest incarnation of one of the most-enduring printer models ever introduced. This time around, Epson has added a new high-speed draft mode, Epson's tradition-in-the-making SmartPark system, a 9- by 7-inch high-density draft print matrix, an additional character set, and a new optional dual-bin cut-sheet feeder. If you had to choose only one printer to bring with you all over the world, this is the one most likely to work with PCs and PC software everywhere.

The Epson FX-1050 is a wide-carriage 9-pin printer that will neither hog your desktop nor save space. You can feed it paper up to 16 inches wide (always from the rear of the printer). Standard paper handling includes friction (pressure) feed and an internal push tractor. A \$74 external pull tractor, a \$249 150-sheet single-bin cut-sheet feeder, and a \$349 dual-bin feeder are options.

A nonbuffered parallel interface is standard; serial, IEEE, and buffered parallel interfaces are optional. With the addi-

## Epson FX-1050 Fonts & Features

Epson FX		Draft	Letter	Auto-Select	Underline
10 cpi 12 cpi Compressed Proportional					
IBM Proprinter 8-pin		Draft	Letter	Auto-Select	Underline
10 cpi 12 cpi Compressed Proportional					

tion of the SmartPark system, paper loading and paper parking are an admirable one-button affair. Multipart forms and card stock worked well in paper-feed tests.

The FX-1050 is character-compatible with the Epson MX and FX series printers as well as with the IBM 5150 Graphics Printer. Graphics compatibilities include Epson MX and FX and IBM Graphics Printer and Proprinter. If you want to use this printer in IBM Graphics Printer emulation mode, you just set a single DIP switch.

While the FX-1050 may be "only" a 9-pin printer, its print quality is certainly good enough for reports short of a thesis or dissertation. In NLQ mode, the FX-1050 isn't as good as a laser or a 24-pin printer, but it will handle wide continuous-form paper like no laser can and will outspeed any 24-pin dot matrix. In normal draft mode at 10 characters per inch, the FX-1050 hit roughly 140 characters per second. High-speed draft mode, a slightly less

C. ITOH 5000



**PC FACT FILE**

C. Itoh Electronics Co., 2505 McCabe Way, Irvine, CA 92714-6297; (800) 347-2484, (714) 660-1421.  
List Price: \$1,995.  
Dimensions (HWD): 6.75 x 17.16 x 23.75 in.  
Weight: 33 lbs.  
Emulations: IBM Proprinter XL, Epson FX-286e, and DEC LA50 LA75 LA210.  
In Short: A solid, fast 18-pin printer featuring convenient user profiles aimed at a multiuser environment—with a few features to come.

CIRCLE 612 ON READER SERVICE CARD



## When you pick a printer for the office, the only thing you have to fear is being wrong.

An office printer can cost a few hundred dollars, or it can cost as much as a small car. And depending on how well it does (or doesn't do) what everybody in the office wants it to do, it can cost you a lot of sleep.



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facsimiles, copiers and shredders.

For the name of our nearest dealer, call 1-800-999-6872. Or write AEG Olympia, Box 22, Somerville, NJ 08876-0022. You can't go wrong with good technology. **Where technology counts, business counts on us.**

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#### a. Your Personal Information

Requested Line of Credit \$ \_\_\_\_\_

Your Name \_\_\_\_\_ First \_\_\_\_\_ Initial \_\_\_\_\_ Last \_\_\_\_\_ Date of Birth \_\_\_\_\_ Mo. Day Yr.

Present Address \_\_\_\_\_ Street \_\_\_\_\_ Apt. # \_\_\_\_\_ City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

Social Security Number \_\_\_\_\_ ( ) \_\_\_\_\_ Home Phone \_\_\_\_\_

Date of Residence \_\_\_\_\_ Month \_\_\_\_\_ Year \_\_\_\_\_ Monthly Payment \$ \_\_\_\_\_ ☐ Buy ☐ Rent ☐ Other \_\_\_\_\_

Previous Address \_\_\_\_\_

\_\_\_\_\_ Dates of Residence \_\_\_\_\_ From \_\_\_\_\_ To \_\_\_\_\_

Your Employer \_\_\_\_\_ (If self-employed, see near panel.)

Date of Employment \_\_\_\_\_ Mo. \_\_\_\_\_ Yr. \_\_\_\_\_ Position \_\_\_\_\_

Monthly Income \_\_\_\_\_ Gross \$ \_\_\_\_\_ Net \$ \_\_\_\_\_

Employer's Address \_\_\_\_\_ Street \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_ Business Phone \_\_\_\_\_

Previous Employer \_\_\_\_\_ Address \_\_\_\_\_

\_\_\_\_\_ Dates of Employment \_\_\_\_\_ From \_\_\_\_\_ To \_\_\_\_\_

Other Income \_\_\_\_\_ I have received since (Date \_\_\_\_\_)

(Income from alimony, child support or spousal maintenance payments need not be disclosed if you do not wish to have it considered as a basis for repaying this obligation)

Monthly Income \_\_\_\_\_ Gross \$ \_\_\_\_\_ Net \$ \_\_\_\_\_

Name and Address of Nearest Relative Not Living With You \_\_\_\_\_

\_\_\_\_\_ Relationship \_\_\_\_\_

#### b. Credit Information

Include joint information, if joint account requested.

Bank Account \_\_\_\_\_ Bank Name \_\_\_\_\_ ☐ Checking ☐ Savings \_\_\_\_\_

Address \_\_\_\_\_

Bank Account \_\_\_\_\_ Bank Name \_\_\_\_\_ ☐ Checking ☐ Savings \_\_\_\_\_

Address \_\_\_\_\_

Bank Loan \_\_\_\_\_ Bank Name \_\_\_\_\_ Address \_\_\_\_\_

\_\_\_\_\_ Payment \_\_\_\_\_ Balance \_\_\_\_\_

Bank Card \_\_\_\_\_ Bank Name \_\_\_\_\_ Address \_\_\_\_\_

\_\_\_\_\_ ☐ VISA ☐ Mastercard Payment \_\_\_\_\_ Balance \_\_\_\_\_

(please check appropriate box):

- ☐ **Joint Credit** with another person. Complete all information.  
☐ **Individual Credit** but rely on income or assets of another person as a basis for repaying the credit requested. Complete all information  
☐ **Individual Credit** Complete sections "a" and "b" only.

Please complete all appropriate sections, providing at least two years' residence and employment history. This will enable your information to be processed as quickly as possible. If you are self-employed, please be sure to complete section "d" below.

Other Credit Card References

Bank Name \_\_\_\_\_ Address \_\_\_\_\_

\_\_\_\_\_ Payment \_\_\_\_\_ Balance \_\_\_\_\_

Other Credit References \_\_\_\_\_ Payment \_\_\_\_\_ Balance \_\_\_\_\_

Account No. \_\_\_\_\_ Expires \_\_\_\_\_

Driver's License No. \_\_\_\_\_ State \_\_\_\_\_ Expires \_\_\_\_\_

#### c. Joint Personal Information

Joint Name \_\_\_\_\_ First \_\_\_\_\_ Initial \_\_\_\_\_ Last \_\_\_\_\_

Date of Birth \_\_\_\_\_ Mo. Day Yr. Social Security Number \_\_\_\_\_

Address \_\_\_\_\_ Street \_\_\_\_\_ Apt. # \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

Date of Residence \_\_\_\_\_ Mo. Yr. Home Phone ( ) \_\_\_\_\_

Employer \_\_\_\_\_

Date of Employment \_\_\_\_\_ Mo. Yr. Position \_\_\_\_\_

Monthly Income \_\_\_\_\_ Gross \$ \_\_\_\_\_ Net \$ \_\_\_\_\_

Employer's Address \_\_\_\_\_ Street \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_ Business Phone \_\_\_\_\_

\_\_\_\_\_ ( ) \_\_\_\_\_

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#### d. Self-Employed Information

Complete this section only if you are self-employed.

Business Name \_\_\_\_\_

Business Address \_\_\_\_\_

☐ Proprietorship ☐ Corporation ☐ Partnership Business Phone ( ) \_\_\_\_\_

Description of Business \_\_\_\_\_

Your Position \_\_\_\_\_ In Business Since \_\_\_\_\_

Your annual income from business \_\_\_\_\_ Business' annual income (gross) (net)

You must provide at least one of the following:

1. Business Bank \_\_\_\_\_

( ) \_\_\_\_\_ Telephone \_\_\_\_\_ Personal Banker's Name \_\_\_\_\_

2. Accountant's Name \_\_\_\_\_

( ) \_\_\_\_\_ Telephone \_\_\_\_\_

3. Financial statement on business attached.

(EXC. AK, & HI)

**PRINTERS**  
**MONOCHROME DOT MATRIX**

**EPSON FX-1050**



**PC FACT FILE**  
**EDITOR'S CHOICE**

Epson America Inc., 2790 Lomita Blvd., Torrance, CA 90505, (800) 922-8911.  
List Price: \$799.  
Dimensions (HWD): 6.5 x 24.5 x 14 in.  
Weight: 27.5 lbs.  
Emulations: Epson FX, IBM Graphics Printer  
In Short: A true standard, the Epson FX-1050 is a workhorse 9-pin, wide-carriage dot matrix printer suitable for home office or business use. This upgraded model has a new high-speed draft mode, Epson's smooth SmartPark paper parking, and an additional character set.

CIRCLE #13 ON READER SERVICE CARD

dense type, clocks in at 166 cps. Expect NLQ print speeds to be around 50 cps. These speeds are excellent for the price. Another advantage of 9-pin heads over 24-pin heads is loudness; the FX-1050 measured only 72 decibels on the PC Labs noise-level test.

The FX-1050 has two NLQ character fonts, Epson roman and Epson sans serif, both in fixed and proportional pitches. And while there's no provision for additional font cartridges, it would be tough to find font software incompatible with the FX-1050.

Control-panel operation uses 7 buttons, 11 lights, and simple tones to control paper handling, font, character pitch (characters per inch), and condensed mode. If you use the optional dual-bin sheet feeder, you can also switch between bins by touching one button on the control panel.

Wider carriages need wider ribbons, and the FX-1050 uses a \$15 harmonica-style ribbon rated at 3 million characters. No film ribbon is available, and there's no color option for the FX-1050. You don't get a plastic glove with the ribbon, but you shouldn't need one; ribbon installation is a breeze.

The standard printer buffer is 8K, with no upgrades available unless you shell out \$175 for the 32K buffered parallel interface. But if you need a print buffer, buy a separate unit—they're cheaper.

Need one printer for spreadsheets, database reports, graphics, and word processing? Like comfort and security in an industry where those two are tough to come by? Get an Epson FX-1050.

## Epson LQ-510

by Bruce Brown

If 9-pin dot matrix print isn't good enough but you don't need laser quality, 24-pin dot matrix printers are a step up that won't destroy your budget but will deliver excellent print quality. Epson offers three levels of 24-pin printers, from entry-level units to

### Epson's SmartPark

### single-button paper-

### loading and -parking

### system is without doubt

### the standard for

### others. SmartPark works

### quickly, easily, and

### smoothly.

fast, heavy-duty office machines. The \$529 LQ-510 is Epson's current low-end 24-pin product, an upgrade from last year's LQ-500.

What's new? This year's version boasts resolution at 360 by 360 dots per inch in graphics mode, a selectable 1- or 8K buffer, a built-in push tractor with automatic single-sheet feeding, Epson's admirable SmartPark paper-handling system, envelope-printing capability, a lower noise level (76 decibels on our test), push-button condensed print mode, and a new legal character set. In addition, 200,000-character film ribbons and a \$99 multifont cartridge font module are newly available.

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CIRCLE 176 ON READER SERVICE CARD

## DOT'S GOOD ENOUGH FOR ME! DOT MATRIX TECHNOLOGY EXPLAINED

by Alfred Poor

Who wants yesterday's technology, even if it is dressed up in fancy cases with tricky trimmings? Surprisingly enough, it would appear that the majority of desktop PC users are satisfied with what amounts to the same old stuff.

The point is this: aside from some new tricks in areas like paper handling and front-panel controls, dot matrix technology is essentially unchanged since *PC Magazine's* first printer project six years ago. The method of making a mark on the paper remains the same, although the quality of the result has improved.

The "dot matrix engine" diagram shows the basic components for putting a dot on the page. The transmission method begins with a thin wire, called a pin, that is mounted in a tube. How thin is thin? Depending on the number of pins in the printhead, the diameters typically range between 0.2 and 0.3mm—as small as or smaller than the point of a 00 drafting pen.

When a pulse of current is sent through the electromagnet coils, the pin shoots forward, striking the paper through the inked ribbon and transferring the ink to the paper. A spring quickly retracts the pin so that it is ready to fire again. Some printers drive the pin directly (as in this example), while others use levers to transfer the motion generated by the magnets to the pins.

Most printheads have either 9 or 24 pins, though there are other configurations available. The 9-pin heads usually arrange all nine pins in a single vertical column, while 24-pin heads usually have three offset columns of eight pins each.

In order to fit all these pins in close proximity, the magnets are often arranged in a radial pattern (shown in the "9-pin dot matrix" diagram) that resembles an early biplane motor.

The changes in dot matrix printing have been evolutionary, not revolutionary, as designers have figured out how to get better quality from the original concepts. The most obvious improvements have come in the type quality of these

printers—even some 9-pin printers now offer good near-letter-quality output.

The improvement has been made possible through more-accurate tracking of the printhead. The position can be controlled more precisely at higher speeds than before, so the individual printed dots can be overlapped more carefully to create fuller characters. The two leading techniques for achieving this control are plastic worm gears and belt drives that move the printhead back and forth across the page.

There are two other dot matrix technologies in existence: line printers and ink jets. A line printer uses a row of pins that spans the full width of the paper. Dots are overlapped by shutting the whole head back and forth while printing. The print quality tends to be poorer, but the design can make for fast output.

Ink jets spray droplets of ink rather than using a ribbon, but in general the technique and results are similar to impact dot matrix printers. The big advantages of ink jets are quiet operation and good coverage of dark areas in graphics. Some ink jets re-

main the best choices for low-cost color output, while others are now good enough to be considered a cheap alternative to a laser printer.

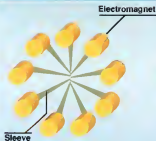
Even if dot matrix technology hasn't made stunning leaps, some changes have come about that make its use a lot more pleasant. Dot matrix printers offer much better paper handling than ever before; you can now get multiple paper paths, intelligent forms parking, and even bins for cut sheets and envelopes, all on the same printer. And front panels are more intelligent. You can select fonts, speeds, and other configurations by pressing buttons. Some printers use LCD message windows to tell you what settings have been chosen, while others play a little tune when your settings are complete.

So while there is little new under the dot matrix sun, the breed continues to thrive. Based on a look at the top machines in this year's printer roundup, it seems safe to assume that impact dot matrix will continue to coexist alongside our PCs for quite some time to come.



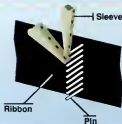
### DOT MATRIX PRINTER ENGINE

#### 9-pin dot matrix



To put a dot on a page, a dot matrix printer sends a pulse of current through the electromagnet coils, making the pin shoot forward, striking the paper through the inked ribbon, and transferring the ink to the paper. A spring quickly retracts the pin so that it is ready to fire again.

#### Dot matrix engine

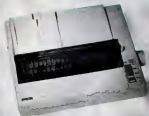


The 9-pin dot matrix heads usually arrange all 9 pins in a single vertical column, while 24-pin heads usually have 3 offset columns of 8 pins each. In order to fit all of these pins in close proximity, the magnets are often arranged in a radial pattern resembling an early biplane motor.



**PRINTERS**  
**MONOCHROME DOT MATRIX**

**EPSON LQ-510**



**PC FACT FILE**



Epson America Inc., 2780 Lomita Blvd., Torrance, CA 90505; (800) 922-8911.  
List Price: \$529  
Dimensions (HWD): 4.25 x 17.375 x 13.5 in.  
Weight: 13 lbs.  
Emulations: Epson LQ-1500, IBM Graphics Printer  
In Short: The LQ-510 is Epson's entry-level 24-pin narrow-carriage printer. It's not fast, but the LQ-510 gives you a selection of letter-quality fonts and is very easy to use. Upgrades over the LQ-500 include Epson's SmartPark system, 360-by-360-dot-per-inch graphics capability, a built-in push tractor, a lower noise level, envelope printing capability, a legal character set, and a front-panel button for condensed-mode type

**CIRCLE #14 ON READER SERVICE CARD**

consists of 6 buttons and 16 small lights. From the panel, you direct paper loading and parking, form and line feed, font selection, and condensed-mode print. A blinking light on the control panel indicates microadjustment operation.

When the internal paper thickness lever is set to position 4 or higher (for multipart forms), a microadjustment feature lets you control paper movement by 1/100 inch, which is a very helpful feature with pre-printed forms requiring print on lines and within boxes.

If you're looking for a 24-pin dot matrix NLQ printer, the LQ-510 is Epson's least expensive entry. It's a competent printer with intelligent paper handling, excellent type, and a reasonable price that's often discounted by one-third or more. A few hundred dollars extra will buy you Epson's LQ-850 (not reviewed here), which is faster and offers more resident fonts. The LQ-510 is an entry-level system intended for home or light-duty office work. If you intend to subject it to heavier use, jump a notch higher in the Epson line.

The LQ-510 comes standard with a nonbuffered parallel interface; serial, buffered serial, IEEE, and 32K buffered parallel interfaces are options. The LQ-510 uses Epson's harmonica-style S9 ribbon, which has a rated life of 2 million characters. Paper up to 10.1 inches wide feeds from the rear only. In testing, multipart forms and card stock worked just as easily as single-sheet continuous paper.

Epson's SmartPark single-button paper-loading and -parking system is without doubt the standard for others. SmartPark works quickly, easily, and smoothly. Just one tap of a button manipulates the paper in any number of convenient ways.

The LQ-510 is Epson LQ-1500 character-mode compatible, as well as graphics compatible with the Epson MX and FX series and the IBM 5150 Graphics Printer. Built-in character fonts include Epson draft, Epson roman, and Epson sans serif fonts. Roman and sans serif are NLQ fonts available in 10, 12, and 15 characters per inch and with proportional spacing. Proportional type isn't an option in draft mode.

If you want more than the standard fonts, there are optional cartridges: five

**Epson LQ-510**  
**Fonts & Features**

**Epson LQ-1500**

	Best	Basic	Sub-Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

single-font NLQs for \$59 each or a \$99 Multi-Font Module that includes Epson versions of Courier, Prestige, Script, OCR-B, OCR-A, Orator, and Orator-S fonts. The Multi-Font Module is a new item for Epson LQ-series printers and a much more economical alternative to single-font units.

The LQ-510's print quality is excellent. The company's high-end LQ printers are faster and have more resident fonts, but there's no perceptible difference in quality. In Epson Roman NLQ mode, the LQ-510 achieved 41 characters per second, while draft came in at 82 cps on our tests.

Most printer operations are selected from the LQ-510's control panel, which

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**CIRCLE 140 ON READER SERVICE CARD**

## Epson LX-810

by Bruce Brown

The \$299 Epson LX-810 is the abacus of dot matrix printers—it's cheap and it completes light jobs with neither frills nor fuss.

The LX-810 is a narrow-carriage, 9-pin dot matrix printer. It doesn't have a color option, proportional spacing, or plug-in font cartridges. All that the LX-810 offers is simple, smooth paper handling, clear type, and reasonable speed—all at a commodity-level price. The LX-810 is also one of the most widely available printers, with a common street price of under \$200. An upgrade from the LX-800, the LX-810 adds high-speed draft, condensed-mode panel control, a 4K print buffer, and non-volatile default-setting memory.

The LX-810 isn't small enough to take on the road with a laptop computer, but at 12.75 pounds, this light Epson is easy to move around an office or house, and it doesn't take up much space. A straight parallel interface is standard, with two types of serial interfaces and a 32K buffer parallel interface optional.

The only emulation is Epson LQ-1500, using the ESC/P command set. There are two resident NLQ fonts, Roman and sans serif, and regular and high-speed-draft print modes. If you want more fonts, look elsewhere or use software to create them. While the print quality won't shame 24-pin printers, the LX-810 holds its own against other 9-pin models. In regular draft mode at 10 cpi, the LX-810 scored 94 characters per second on our tests; in the less-dense

### EPSON LX-810



**FACT FILE**  
**EDITOR'S CHOICE**

Epson America Inc., 2780 Lomita Blvd.,  
Torrance, CA 90505; (800) 922-8911.  
List Price: \$299.

Dimensions (HWD): 5.5 x 17.5 x 13.75 in.  
Weight: 12.75 lbs.

Emulations: Epson LQ

In Short: This terrific little printer adds to the LX-800, including the SmartPark paper-handling system, a high-speed draft mode, condensed-mode type via the front panel, a 4K print buffer, and non-volatile default settings. The street price for the LX-810 is usually under \$200, making it an incredible buy. If you need a spare printer, an extra printer for home, or a printer for a student, grab this one.

CIRCLE #18 ON READER SERVICE CARD

high-speed draft mode, it clocked in at 113.5 cps. NLQ mode exacts a heavy speed toll, with a test score of 27 cps.

High-speed draft mode is set via a DIP switch located on the right side of the printer; switch settings are clearly referenced in the manual. There are just four buttons and four LED lights on the LX-810's control panel. Use these to choose NLQ font or draft quality and to turn condensed mode on or off—single or multiple tones signal your changes.

Paper handling is one of the LX-810's best features, one that sets it apart from other vendors' low-end dot matrix offerings. The LX-810 uses the same smooth SmartPark system found in Epson's more-expensive printers—a foolproof single-button operation. Paper-handling options include a \$59 external pull tractor and a \$120 150-sheet single-page feeder.

According to the manual, you can use paper as wide as 10.1 inches and as heavy as 24 pounds. The LX-810 is also rated for multipart forms with three sheets. The printer actually performs above spec; it had no problem printing on and smoothly

handling both four-part forms and card stock. Paper feeds from the rear only.

The LX-810 has a standard 4K buffer; this is expandable only if you buy the optional 32K buffered parallel interface, which, at \$175, just isn't worth it for this printer. The LX-810 is compatible with the IBM high-order character set, printing all high-bit ASCII characters except the delta.

The LX-810 uses common harmonica-style ribbons, which Epson sells for \$9 and rates at a life of 3 million characters. Ribbon installation is simple and not at all messy.

At its low price, the Epson LX-810 is easily affordable as a spare printer for your office. This is a low-end, narrow-carriage dot matrix printer with no hassles and simple operation that's very hard to beat.

## Facit B2400

by Catherine D. Miller

The first thing you notice about the \$699 Facit B2400 is its designer-gray color—not thrilling but attractive nonetheless. This narrow-carriage 24-pin printer further distinguishes itself with its excellent print quality in both draft and NLQ modes.

Setting up the printer is a straightforward process. Ribbon and rear-feed paper installation is smooth, and the setup procedure is uncomplicated. A separate bank of buttons on the control panel regulates the soft setup procedure. Initiated by pressing the Yes button while the printer is off-line, the setup lets you choose the emulation mode (Epson LQ-1500 or the 24-pin IBM Proprietary), serial or parallel interface, character appearance, paper format, and character set.

The best thing about the soft setup procedure is that you can go directly to the category in which you want to make changes. The menu choices are arranged across the page, and by pressing the No button you can jump the printhead from one category to the next. When the printhead is aligned with the category you want to select, press the Yes button and make the configuration changes you wish. This method makes it easy to change a single item in the setup procedure.

As elegant as the setup procedure is, you don't have to use it to vary print quality. A dial on the control panel sets pitch (characters per inch) in both draft and NLQ modes. In draft mode, you can select a pitch of 10, 12, 15, 17, or 20 characters per

### Epson LX-810

## Fonts & Features

#### Epson FX

	Bold	Italic	Sub-Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

#### Epson LQ-1500

	Bold	Italic	Sub-Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

# PRINTERS MONOCHROME DOT MATRIX

inch; in NLQ mode, the pitch value can be set to 10 or 12 cpi or proportional. These settings override pitch commands sent to the printer by your computer. Leave the dial in the middle position, and the printer will obey the pitch commands sent to it by the computer.

The Facit B2400 emulates both the Epson LQ-1500 and the IBM Proprinter (24-pin). Rated at 200 characters per second under Epson mode, the printer achieved a throughput of 111 cps in draft mode but slowed to an average 38 cps in NLQ mode. Print quality in both modes was excellent. The B2400 did a good job with the graphic image, printing it in the right proportions and with the definition you'd expect from a 24-pin dot matrix printer. It had little trouble reproducing the high-order ASCII character set, missing only one character.

The B2400 was significantly lacking in Proprinter mode. Not only was it slow—50.7 cps in draft mode—it also had trouble producing the aspect ratio of our scanned photo test, squashing the image. Representatives at Facit are aware of the problem and say that they have corrected it in the most recent versions of the printer.

Three typefaces are built into the Facit B2400: Courier, Elite, and Micron. A slot on the upper-left side of the printer accepts one of 14 font cards, available for \$95 each, or an installation card that prints the configuration options in one of several languages. You can also download user-defined characters.

The Facit B2400 features some nice paper-handling capabilities, most notably

FACIT B2400



## PC FACT FILE

Facit Inc., 400 Commercial St., P.O. Box 9540, Manchester, NH 03108-9540; (603) 647-2700.  
List Price: \$699  
Dimensions (HWD): 5.2 x 17.8 x 13 in  
Weight: 17.5 lbs  
Emulations: Epson LQ-1500, IBM Proprinter (24-pin)  
In Short: An attractive narrow-coverage 24-pin printer that produces great-looking type and graphics, the Facit B2400 is further distinguished by an elegant configuration procedure.

CIRCLE 818 ON READER SERVICE CARD

its one-button paper parking. To park the paper, simply push the Park button on the control panel, and the continuous-feed paper moves smoothly out of the way. A flick of the load lever, located on the right side of the printer next to the platen knob, moves the infold paper back into place. Loading paper is also a breeze. Optional sheet feeders are available at \$175 for single-bin and \$225 for a dual-bin.

By varying the platen-to-printhead gap, you can set the printer to handle multipart forms. It had no trouble with our multipart art carbon form or cardboard stock tests.

At 80 decibels in draft mode, the Facit B2400 is a little on the loud side but not ear-shattering. While pushing a quiet button located on the control panel hushes things down to 75 db, it also makes a dent in the printer's speed.

The quadrilingual (English, French, German, and Swedish) user manual accompanying the printer is terse, relying on diagrams to explain procedures.

A good-looking and durable printer featuring elegant configuration procedures and terrific type, the Facit B2400 is a good choice for many offices doing lots of word processing. With improved NLQ speed, it would be even more attractive.

Facit B2400

## Fonts & Features

### IBM Proprinter X24

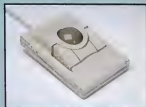
	Bold	Italic	Sub-Script	Underline
10 cpi	■	■	■	■
12 cpi	■	■	■	■
Compressed	■	■	■	■
Proportional	■	■	■	■

### Epson LQ-1500

	Bold	Italic	Sub-Script	Underline
10 cpi	■	■	■	■
12 cpi	■	■	■	■
Compressed	■	■	■	■
Proportional	■	■	■	■

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## Fortis DM 2210

## Fortis DM 2215

by Bruce Brown

Fortis's pair of low-end 9-pin dot matrix printers are a feature and performance bargain with but one minor design problem. Priced at \$499 for the narrow-carriage Fortis DM 2210 and \$599 for the wide-carriage DM 2215, both printers are Epson FX and IBM Proprinter compatible and include the usual complement of features. The only drawback is a weak paper-feed system that sometimes binds the first sheet when you use continuous-form paper.

Other than case width and weight, the DM 2210 and DM 2215 are identical, including their shared problem with paper feeding. The Fortis design allows you to rip off a sheet of printed continuous-form paper without wasting a sheet by advancing

an extra page first. This idea is a good one; unfortunately for the Fortis pair, when you start subsequent printing jobs with the first sheet starting at the print-head, jams are common enough to warrant critical mention. Wasting paper is regrettable, but the aggravation and wasted time caused by paper jams have an equal or greater cost.

I was able to print on multipart forms with these printers, but they did a poor job on the card stock, bucking a bit at the admittedly heavier-than-spec paper.

On a brighter note, the Fortis DM 2210 and DM 2215 have modern paper parking for easy continuous paper loading and temporary unloading for cut-sheet paper printing. All you have to do is place continuous-form paper in the push-tractor sprockets and pull a single lever on the top

front of the printer to feed the paper in easily, automatically positioning the paper at the first printing position.

The DM 2210 is the narrow-carriage version of this model, printing on paper up

**Fortis's 9-pin printers  
have modern paper parking  
for easy continuous  
paper loading.**

to 10 inches wide. The wider DM 2215 has a maximum paper width of 16 inches. The DM 2210 uses Epson-like harmonica-style

## HP DESKJET PLUS: A Lot like a Laser

by Alfred Poor

If it looks like a duck, quacks like a duck, and waddles like a duck, only slower, do you think it might be a duck? The \$995 Hewlett-Packard DeskJet Plus may not be a laser printer, but a lot of people may decide that it's close enough. On the other hand, it's like a dot matrix in many ways. But really it's in a class by itself.

And even if we could decide whether it is a laser or a dot matrix, the DeskJet Plus—because it doesn't offer any of the standard PC printer emulations—doesn't fit our filter for review. Of course, with widespread application support, the DeskJet Plus doesn't need to emulate other printers—not even its LaserJet siblings. But never fear—the DeskJet Plus does respond to most of the LaserJet commands and, in fact, I was able to run almost all of the PC Labs printer benchmarks using the LaserJet driver.

The list price of the DeskJet Plus leans toward the high end of dot matrix prices, (though its street price is closer to \$700), but it's a bargain for a laser. And as HP's new 4-page-per-minute LaserJet Series IIP takes off at a street price of around \$1,000, one can hope that HP will drop the DeskJet Plus's price even lower. At press time, however, spokespersons from HP adamantly

stated that there were no plans to make the DeskJet Plus any cheaper.

It may strike you as presumptuous for an ink jet printer to be compared with laser printers, but there are good reasons for the comparison. The DeskJet Plus prints with 300-dpi resolution and uses only cut-sheet paper, just like a laser. It is nearly silent as it prints and

graphics speed test using the DeskJet Plus driver in about 26 seconds, a speed no laser has matched.

There are other differences. The DeskJet Plus comes with only 16K of RAM, which is used as a buffer. The printer can accept downloaded fonts, but you must first add more memory in the form of a removable RAM cart-

### Hewlett-Packard DeskJet Plus

\$995 300-dpi, 2-ppm ink jet printer



produces smooth, solid black images, just like a good laser.

Unfortunately, the DeskJet Plus falls short of laser territory in speed; where lasers typically crank out 6 to 10 pages per minute in our text speed test, the DeskJet Plus barely made 2 ppm in its quality text mode and only about 0.5 ppm faster in draft, though these speeds are faster than those of the original DeskJet. On the other hand, the DeskJet Plus managed to blast through the

ridge—either 128K or 256K. Another disappointment is that the downloadable fonts are similar to but not interchangeable with LaserJet soft fonts.

You can also get fonts in cartridges, just like a LaserJet, but these, too, are different from the LaserJet version and aren't interchangeable. There are two cartridge slots, so you're limited in terms of how much downloading memory and cartridge fonts you can have on-line at one time.

# PRINTERS MONOCHROME DOT MATRIX

ribbons listing at \$8.50, and the DM 2215's ribbons cost \$12.50. Expected ribbon life is 800,000 characters before noticeable type lightening.

Character print quality is acceptable with these 240- by 72-dot-per-inch printers, given the restrictions of 9-pin design. Two NLQ fonts, Courier and Gothic, are resident. As of this writing, Fortis is preparing an optional font cartridge that will reportedly include six fonts and cost approximately \$65.

The printers are relatively speedy, with rates of 131 characters per second in draft mode and a reasonable 39 cps in NLQ mode on our tests. NLQ proportional mode printing increases the speed slightly, to 40 cps.

Both parallel Centronics-type and 6-pin DIN serial interface connectors are standard. The printers use friction feed for single sheets and an internal push tractor for

continuous forms. An optional \$219 single-bin cut-sheet feeder holds 150 sheets. And \$159 buys an extra bin that attaches to the single-bin model, adding another 150 sheets to the capacity.

The standard buffer size is 16K, which can be configured at either 6- or 16K, depending on your preference. A 32K buffer upgrade costs \$65.

The printers' control panel is located on a flat horizontal shelf on the bottom front of the units. The panel consists of a combination of 6 buttons, 4 LEDs, and a 16-character liquid-crystal display. The LCD gives information about the current print mode and character style and is used to select various printer settings when the printer is in Menu mode. You also have the option of saving two menu-setting configurations—convenient if you like to use

must do this manually, one envelope at a time.

The output quality is terrific. Graphics images tend to be a little on the dark side, and you can lose a bit of definition from the ink spreading in areas of heavy print, but the overall results beg to be

## The DeskJet PLUS prints with 300-dpi resolution and uses only cut-sheet paper, like a laser.

compared to lasers and not to impact dot matrix machines. Unfortunately, the ink is not waterproof—a drop of rain can smear the address on an envelope or ruin a report cover.

If you dream of a laser printer but just can't find the funds to land one on your desk, the DeskJet Plus may be close enough to the real thing. It doesn't quite match the output quality of most lasers, but it beats the average dot matrix model. For most text applications, the DeskJet Plus will respond correctly

Fortis DM 2215

## Fonts & Features

### Epson FX

	Bold	Italic	Subscript	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

### IBM Proprinter 8-pin

	Bold	Italic	Subscript	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

to LaserJet commands, so it can be expected to work with a wide range of applications. It's also expandable, so you won't outgrow it too soon. The biggest liabilities are the slower text speed and the water-vulnerable ink. If those are not major problems, then the DeskJet Plus represents an attractive value. ■

## EDITOR'S CHOICE

Hewlett-Packard DeskJet Plus  
Hewlett-Packard Co., 3000 Hanover  
St., Palo Alto, CA 94304; (800) 752-  
0900.

List Price: \$995.

Dimensions (HWD): 8.12 x 17.12 x  
15 in.

Weight: 14.3 lbs.

Emulations: DeskJet

In Short: With cut-sheet paper handling, 300-dpi resolution, and excellent print quality, the Hewlett-Packard DeskJet Plus demands to be compared with lasers and not with impact dot matrix printers. It is not as fast as a LaserJet, and the ink can smear if it gets wet, but this unit is largely compatible with the LaserJet command set and can be easily expanded. At its price, the DeskJet Plus makes an excellent alternative for those who feel that they cannot afford the extra money to get a true laser.

CIRCLE 619 ON READER SERVICE CARD

**PRINTERS**  
**MONOCHROME DOT MATRIX**

**FORTIS DM 2210**  
**• FORTIS DM 2215**



**FACT FILE**  
**EDITOR'S CHOICE**

Fortis Information Systems Inc., 6070 Rickenbacker Rd., Commerce, CA 90040; (213) 727-1227.  
List Price: DM 2210, \$499; DM 2215, \$599.  
Dimensions (HWD): DM 2210, 5.75 x 16 x 15.75 in.; DM 2215, 5.75 x 23 x 15.75 in.  
Weight: DM 2210, 18 lbs.; DM 2215, 23 lbs.  
Emulations: Epson FX Series, IBM Proprinter (9-pin).  
In Short: The Fortis DM 2210 is the narrow-carriage version and the DM 2215 is the wide-carriage version of this 9-pin dot matrix. Both are fairly speedy printers with reasonable character and graphics quality. The paper-feed systems jam too easily.

CIRCLE 628 ON READER SERVICE CARD

special settings for more than one type of regular printing job.

With the single exception of their propensity to jam continuous-form paper, the Fortis 9-pin printers offer good values. At only a \$100 premium, the 136-column Fortis DM 2215 gives you more flexibility than the 80-column DM 2210. An Epson- and IBM-compatible wide-carriage printer with a true draft-quality speed of over 130 cps is a good deal at under \$600 list. If you don't have the desk space or just don't want a wide printer, the \$499 DM 2210 is also a fine choice.

## Fortis DQ 4110

by Bruce Brown

Same price, different advantages. Fortis's DQ 4110 low-end 24-pin dot matrix printer costs the same as its DM 2210 9-pin narrow-carriage printer. The clear trade-off is speed for print quality. This 24-pin printer comes with five resident letter-quality fonts but has a top speed of only about 100 characters per second in draft mode. But if

you buy the \$499 DQ 4110 for its handsome type, you may not mind the extra wait.

Move from draft mode to NLQ mode, and the speed improves almost as much as the print quality. The DQ 4110's NLQ print speed is a respectable 49 cps, and proportional NLQ is even better at 58.5 cps. In both cases, output is excellent.

The DQ 4110 emulates both the Epson LQ and the IBM Proprinter and passed the compatibility tests for both printer families, missing only the delta sign. As for fonts, the DQ 4110 includes a draft font as well as having Courier, Gothic, Prestige, OCRB-EXT, and Optimo fonts resident. An optional font cartridge includes Script and Orator fonts for \$79. If you intend to use the printer to produce notes for speeches or lectures, Orator is a terrific open font for that purpose.

The standard interfaces include a Centronics parallel and a 6-pin DIN serial, configurable up to 9,600 bits per second. The DQ 4110 has an internal push-type tractor feed as well as optional single-bin and dual-bin cut-sheet feeders.

Like the Fortis 9-pin printers, the DQ 4110 has a parking system both for loading continuous-form paper and for getting it out of the way while you print on cut sheets. This printer suffered from the same jamming problems when printing at the very top of a continuous-form page, but the incidence of the problem was minor compared with the frequency with which it

**FORTIS DQ 4110**



**FACT FILE**

Fortis Information Systems Inc., 6070 Rickenbacker Rd., Commerce, CA 90040; (213) 727-1227.  
List Price: \$499.  
Dimensions (HWD): 15.25 x 16 x 15.0 in.  
Weight: 18 lbs.  
Emulations: Epson FX Series, Epson LQ-1500, IBM Proprinter (9-pin).  
In Short: The DQ 4110 is a slower version of the Fortis DQ 4210 at a savings of \$200. Its under-\$500 price makes this 24-pin dot matrix printer with five letter-quality fonts and just-OK speed a good deal. Not intended for heavy duty cycles, the DQ 4110 is an acceptable but unexciting printer.

CIRCLE 621 ON READER SERVICE CARD

happened on the Fortis 9-pin printers. The DQ 4110 did a fine job of printing on multipart forms and handled the card stock adequately on PC Labs' real-world paper-handling tests.

The DQ 4110 shares the same control panel as the DQ 4210, with its combination of a 16-character LCD status and menu screen, six flush buttons, and four indicator lights. You can save two combinations of printer-function menu settings for easy recall for specific jobs. The DQ 4110 has a standard 24K printer buffer that can be expanded to a maximum of 56K with a \$60 32K option.

The Fortis DQ 4110 is an interestingly priced and positioned dot matrix printer. At the same price as the DM 2210 but with better print quality by virtue of its 24-pin configuration, the DQ 4110 is most suited for people who need a low-cost printer that gives the best possible type and for whom speed is not an issue. If you need both good-quality 24-pin type and higher speed, look at Fortis's DQ 4210 (reviewed here), a close cousin of the DQ 4110 that shares many of the same features but is almost as fast as the DM 2210.

### Fortis DQ 4110 Fonts & Features

	Epson FX			
	Bold	Italic	Half-Height	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				
	IBM Proprinter 9-pin			
	Bold	Italic	Half-Height	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

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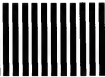
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  - ☐ 286 systems
  - ☐ 386 systems
  - ☐ Peripherals
  - ☐ Other
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  - ☐ Consultant
  - ☐ Reseller
  - ☐ Corporate purchaser
  - ☐ DP/MIS
  - ☐ Business owner
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- ☐ 1-25
  - ☐ 26-100
  - ☐ Over 100
- D. How many PCs does your company plan to purchase in the next 12 months?
- ☐ 1-25
  - ☐ 26-100
  - ☐ Over 100
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- ☐ Corporate/Institutional
  - ☐ Small business
  - ☐ Student/Educational
  - ☐ Home

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- D. How many PCs does your company plan to purchase in the next 12 months?
- ☐ 1-25
  - ☐ 26-100
  - ☐ Over 100
- E. What is your primary computing interest?
- ☐ Corporate/Institutional
  - ☐ Small business
  - ☐ Student/Educational
  - ☐ Home

3024

## Fortis DQ 4210

by Bruce Brown

Fortis's line of dot matrix printers presents some complicated choices. At \$699, here's how the Fortis DQ 4210 compares with other Fortis models: it costs \$200 more than both the DQ 4110, with similar quality print but slower speed, and the DM 2210, with slightly faster speed but lesser-quality print. However, the DQ 4210 offers high-quality 24-pin type at impressive speed. The choice is yours.

The narrow-carriage DQ 4210 is almost identical to the DQ 4110 except that it has a faster stepper motor and some slightly different intelligence on EPROM chips. Standard emulations include Epson LQ-1500 and IBM Proprinter, with five resident NLQ fonts: Courier, Gothic, Prestige, Optimo, and OCRB-EXT. The same \$79 optional font cartridge includes Script and Orator fonts.

The paper-handling alternatives include standard friction feed and internal push tractor as well as optional cut-sheet feeders—\$219 for a 150-sheet single-bin unit and an additional \$159 for a second bin add-on. Paper parking and feeding work fine on this unit, with only occasional jamming if you start at the very top of a new page of continuous-form paper. The DQ 4210 uses Epson-style harmonica-type ribbons rated to last 800,000 characters and priced at \$6.50.

The DQ 4210 registered a respectable 122 characters per second in draft mode, 60 cps in NLQ mode, and 69 cps in NLQ

### FORTIS DQ 4210



### PC FACT FILE

Fortis Information Systems Inc., 6070 Rickmanbacker Rd., Commerce, CA 90040, (213) 727-1227.  
List Price: \$699.  
Dimensions (HWD): 5.25 x 18.0 x 15.0 in.  
Weight: 18 lbs.  
Emulations: Epson FX series, Epson LQ-1500, IBM Proprinter (9-pin)  
In Short: The Fortis DQ 4210 is a midrange 24-pin Epson LQ-, FX-, and IBM Proprinter-compatible narrow-carriage printer with decent speed and five standard letter-quality fonts. The DQ 4210 is a speedier alternative to the DQ 4110 with the same quality print.

CIRCLE 622 ON READER SERVICE CARD

proportional mode on the PC Labs speed test. The print quality on all three counts is the crisp type you would expect from any 24-pin printer.

The DQ 4210's control panel has 6 flush buttons, 4 lights, and a 16-character LCD screen. The LCD screen lists the current print mode, font, and pitch and is also used to set printer-function options such as margins and page length. There are two possible default menus that can be set for specific printing tasks, such as draft print on one paper size and NLQ print on another paper size.

Depending on your operational preference, you can use all or just 8K of the standard 24K print buffer. A 32K buffer-memory-expansion kit costs \$60 and takes the system to its maximum 56K size. A 6-pin DIN serial interface connector is included with the printer, along with the usual Centronics parallel printer port.

The extra \$200 that you pay when you choose the Fortis DQ 4210 over the DM 2210 and DM 4110 buys you both speed and 24-pin quality in a trouble-free model. You could certainly do worse.

### Fortis DQ 4210

## Fonts & Features

Epson FX				
	Bold	Italic	Subscript	Underline
10 cpi	■	■	■	■
12 cpi	■	■	■	■
Compressed	■	■	■	■
Proportional	■	■	■	■

IBM Proprinter 9-pin				
	Bold	Italic	Subscript	Underline
10 cpi	■	■	■	■
12 cpi	■	■	■	■
Compressed	■	■	■	■
Proportional	■	■	■	■

## Genicom 3410XLQ

by M. David Stone

The Genicom 3410XLQ is clearly meant for heavy-duty printing. Everything about the 9-pin printer, from its Bigfoot measurements (19 by 25.25 inches) to its claimed 400-character-per-second speed, emphasizes that fact. The result is a \$2,175 printer that does some things extraordinarily well. Unfortunately, it also suffers from some design flaws.

Paper handling is one of the printer's strongest points. The basic printer gives you two choices for paper feed: bottom and rear. To use the bottom slot, you feed paper through the slot and into the three-pin tractor-feed roller near the printhead.

In a clever piece of engineering, the roller doubles as a friction-feed roller for the rear slot. To use the rear feed, you thread the paper through the rear slot, position it on the built-in push tractor, and then feed it to the roller. When using the rear feed, however, you position the roller so that the pins are out of the way. With either arrangement, paper handling is swift and sure. Press the Form Feed button on the front panel, and the paper moves with a convincing authority. Even better, the paths are so straightforward that paper jams seem unlikely.

Missing from the basic printer is any way to feed single sheets. However, Genicom does sell both single-bin and dual-bin cut-sheet feeders. To use either one, you first have to install a fair number of pieces inside the printer to help guide the paper. These include roller assemblies, plastic paper guides, and a "paper out" sensor. Once you've installed the pieces, the printer can handle cut sheets as easily as continuous-form paper. But it seems silly not to include this capability in the first place, even though it saves a few dollars on the price of the printer.

On the PC Labs text speed test, the

### Genicom 3410XLQ

## Fonts & Features

IBM Proprinter 9-pin				
	Bold	Italic	Subscript	Underline
10 cpi	■	■	■	■
12 cpi	■	■	■	■
Compressed	■	■	■	■
Proportional	■	■	■	■

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2847	<input type="checkbox"/> Basic Compiler 6.0	199.
2859	<input type="checkbox"/> Fortran Compiler 5.0	289.
2853	<input type="checkbox"/> C Compiler 5.1	299.
<b>Monogram ... NCP</b>		
2778	<input type="checkbox"/> Dollars and Sense 3.1	105.
<b>Multisoft ... NCP</b>		
4924	<input type="checkbox"/> Super PC-Kwik 3.3	49.
4925	<input type="checkbox"/> PC-Kwik Power Pak 1.3	79.
<b>Nantucket Software ... NCP</b>		
2970	<input type="checkbox"/> Clipper (Summer '87)	429.
<b>New England Software ... NCP</b>		
3004	<input type="checkbox"/> Graph-in-the-Box 2.2	75.
4337	<input type="checkbox"/> GB-Stat 1.5	159.

<b>Nolo Press ... NCP</b>		
2982	<input type="checkbox"/> WillMaker 3.0	\$35.
5122	<input type="checkbox"/> For The Record 1.0	35.
<b>North Edge Software ... NCP</b>		
2987	<input type="checkbox"/> Timeslips III 3.4	169.
<b>Norton-Lambert ... NCP</b>		
4928	<input type="checkbox"/> Close-Up Customer 3.0	135.
4929	<input type="checkbox"/> Close-Up Support 3.0	165.
5420	<input type="checkbox"/> Close-Up LAN (8 user)	529.
<b>On Track Computer Sys. ... NCP</b>		
5490	<input type="checkbox"/> Disk Manager 4.0	65.
<b>Owl International ... NCP</b>		
3080	<input type="checkbox"/> Guide 2.0	143.
<b>Paperback Software ... NCP</b>		
3142	<input type="checkbox"/> VP-Planner Plus 2.0	145.
3138	<input type="checkbox"/> VP-Expert 2.1	145.
<b>Parsons ... NCP</b>		
3126	<input type="checkbox"/> SeeMORE 2.0	54.
4328	<input type="checkbox"/> Look & Link 1.1	59.
4384	<input type="checkbox"/> Ultravision 1.2	79.
<b>Peter Norton ... NCP</b>		
3152	<input type="checkbox"/> Norton Commander 2.0	52.
3146	<input type="checkbox"/> Advanced Utilities 4.5	89.
3153	<input type="checkbox"/> Norton Editor 1.3	45.
4150	<input type="checkbox"/> Dan Brocklin's Demo Prog. 2.2B	109.
<b>Quarterdeck ... NCP</b>		
3221	<input type="checkbox"/> Expanded Memory Mgr. 386 5.0	59.
3220	<input type="checkbox"/> DESQView 2.26	79.
4586	<input type="checkbox"/> DESQView 386	129.
<b>Reference Software ... NCP</b>		
4396	<input type="checkbox"/> Grammatik IV 1.0	52.
<b>Revolution Software ... NCP</b>		
4480	<input type="checkbox"/> VGA Dimmer 2.01 (screen saver)	19.
3254	<input type="checkbox"/> Cruise Control 3.02	39.
<b>Rightsoft ... NCP</b>		
4155	<input type="checkbox"/> Rightwriter 3.1	54.



North Edge Software ... NCP  
☐ Timeslips III 3.4—Track every minute's efforts, then print the invoice and log the receivable all from the convenience of Timeslips III. Menu-driven and memory resident, this is a must for your service business. .... \$169.

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<b>Samna ... NCP</b>		
5148	<input type="checkbox"/> Ami 1.0A	\$129.
5799	<input type="checkbox"/> Ami Professional 1.0	319.
<b>Simon &amp; Schuster ... NCP</b>		
3314	<input type="checkbox"/> Typing Tutor IV 1.0	33.
<b>Softlogic Solutions ... NCP</b>		
3546	<input type="checkbox"/> Disk Optimizer 4.01	45.
3542	<input type="checkbox"/> Software Carousel 3.01	55.
<b>Software Publishing ... NCP</b>		
3495	<input type="checkbox"/> Professional Plan 1.02	59.
3499	<input type="checkbox"/> PFS:First Publisher 2.1	79.
4342	<input type="checkbox"/> PFS:First Graphics 1.0	89.
3478	<input type="checkbox"/> PFS:First Choice 3.02	105.
3496	<input type="checkbox"/> Professional Write 2.11	139.
3493	<input type="checkbox"/> Professional Write 2.01	189.
3482	<input type="checkbox"/> Harvard Graphics 2.12	299.
4669	<input type="checkbox"/> Harvard Graphics Access. Pk 1.0	299.
4284	<input type="checkbox"/> Harvard Project Manager 3.0	439.



Intuit ... NCP  
☐ Quicken 3.0—Bring your personal or small business finances under control with Quicken. This easy-to-use program works just like your paper check book. Automate check writing, financial reporting, and more ..... \$39.

<b>Spinaker ... NCP</b>		
4441	<input type="checkbox"/> Resume Kit 1.29	25.
4446	<input type="checkbox"/> 8-in-1 2.0	39.
4444	<input type="checkbox"/> Splash 1.0	59.
<b>Symantec ... NCP</b>		
3427	<input type="checkbox"/> Q & A Write 1.01	129.
3412	<input type="checkbox"/> Grandview 1.0	189.
3425	<input type="checkbox"/> Q & A 3.0	219.
3431	<input type="checkbox"/> Timeline 3.0	369.
<b>T/Maker ... NCP</b>		
5540	<input type="checkbox"/> ClickArt Business Images	45.
4185	<input type="checkbox"/> Scrapbook + 1.0	85.
<b>TOPS ... NCP</b>		
3724	<input type="checkbox"/> NetPrint 2.0 (share printers)	119.
3726	<input type="checkbox"/> TOPS 2.1	115.
3725	<input type="checkbox"/> TOPS Repeater (network extender)	129.
3720	<input type="checkbox"/> Flashcard 2.1 (AppleTalk network card; 1 year warranty)	159.
<b>Traveling Software ... NCP</b>		
4190	<input type="checkbox"/> Battery Watch 2.0 (3 1/2" only)	35.
3729	<input type="checkbox"/> LapLink Mac 2.0 (Mac-PC transfer)	79.
5179	<input type="checkbox"/> LapLink III	85.
4891	<input type="checkbox"/> ViewLink 1.0	95.
3727	<input type="checkbox"/> DeskLink 2.21	99.
<b>True BASIC, Inc. ... NCP</b>		
3561	<input type="checkbox"/> True BASIC 2.1	52.

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# Or to illustrate




**Volkwriter ... NCP**  
**W Volkwriter 4 with Correct Grammar**—Makes professional word processing simple. The first and only word processor with a fully integrated grammar corrector ..... \$109.

Vericomp ... NCP	
3765 WSoftBytes 2.0 .....	35.
<b>Volkwriter ... NCP</b>	
5046 W Volkwriter 4 (w/Correct Grammar) 109.	
<b>WordPerfect Corp. ... NCP</b>	
3799 W WordPerfect Library 2.0 .....	75.
3804 W WordPerfect 5.1 .....	265.
3805 W WordPerfect Network 5.1 .....	389.
3806 Additional Network Stations 5.1 .....	89.
<b>WordStar USA ... NCP</b>	
2825 W WordStar Prof. Release 5.5 .....	229.
5000 W Upgrade to Release 5.5 .....	89.
<b>Xerox ... NCP</b>	
4539 W Professional Extensions 1.0 .....	399.
3812 W Ventura Publisher 2.0 .....	call
<b>XTREE Co. ... NCP</b>	
4512 W XTREE Pro 1.1 .....	69.
<b>XYQUEST ... NCP</b>	
4393 W XyWrite III Plus 3.55 .....	229.

## RECREATIONAL/EDUCATIONAL

<b>Broderbund ... CP</b>	
1413 W Where/World Carmen Sandiego? .....	25.
1414 W Where/USA Carmen Sandiego? .....	25.
1417 W Where/Europe Carmen Sandiego? .....	29.
5701 W Where/Time Carmen Sandiego? .....	32.
4948 W JetFighter (by Velocity) .....	35.
<b>Electronic Arts ... CP</b>	
5798 W Ferrari Formula I .....	29.
5806 W F-16 .....	35.
5805 W Starline II .....	45.
5803 W Battle of Britain .....	45.
5804 W Deluxe Paint II (Enhanced) .....	89.
<b>Microprose ... CP</b>	
4454 W F-19 Stealth Fighter .....	39.
2725 W F-15 Strike Eagle .....	22.
<b>Microsoft ... NCP</b>	
2858 W Flight Simulator 4.0 All New .....	39.
<b>Mindscape ... CP</b>	
4897 W Gauntlet .....	29.
4890 W Balance of Power 1990 .....	33.
<b>Parlor Software ... CP</b>	
3159 W Bridge Parlor 2.3 .....	49.

<b>Sierra On-Line ... CP</b>	
3405 W TheDex .....	\$24.
4752 W Gold Rush .....	25.
4455 W Leisure Suit Larry II .....	33.
4345 W King's Quest IV (5.12k version) .....	33.
5695 W Manhunter: San Francisco .....	33.
4456 W Police Quest II .....	33.
3404 W Space Quest II .....	33.
5106 W Space Quest III .....	36.
<b>Spectrum HoloByte ... NCP</b>	
3467 W Tetris (adding mind teaser) .....	24.
4283 W Falcon4 (F-16 simulation) .....	32.
5187 W VETTEL .....	32.
<b>Stone &amp; Assoc. ... NCP</b>	
3436 W Memory Master (ages 2-6) .....	22.
3435 W My Letters, Numbers, Words (2-6) .....	22.
5231 W Phonics Plus .....	22.
3439 W 2nd Math (ages 7-16) .....	27.
<b>Sublogic ... NCP</b>	
4653 W Utopia .....	25.
3335 W Utopia (requires CGA or EGA) .....	39.
<b>True BASIC, Inc. ... NCP</b>	
3559 W Algebra 3 with Workbook .....	33.
3590 W Pre-Calculus with Workbook .....	39.



**Electronic Arts ... CP**  
**W Lakers vs. Celtics**—Play 5-on-5. You control NBA players with all-stars and teams . \$35.  
**W Madden Football**—With over 160 different plays, includes 11 main teams, injuries, time outs, and weather ..... \$35.

## HARDWARE

Manufacturers' standard limited warranty period for items shown is listed after each company name.  
**Some products in their line may have different warranty periods.**

<b>AST Research ... 2 years</b>	
1223 I/O Mini 2 C/S/P .....	89.
1302 SoftPak Plus 64k C/S/P .....	129.
4107 RAM/page Plus 288 512k .....	419.
4105 RAM/page Plus MicroChannel 512k 469.	
<b>Brother International ... 1 year</b>	
5787 HL-8e Laser Printer .....	1899.
5786 HL-8Pc PostScript Laser Printer .....	call
5796 Toner/Drum Kit .....	99.
<b>Central Point ... 1 year</b>	
5042 Copy II PC Deluxe Option Board .....	115.

<b>Compucable ... 2 years</b>	
1604 2-Position switch box .....	\$25.
1605 3-Position switch box .....	35.
<b>Cuesta ... 1 year</b>	
1608 Datasaver 400 Watt (power backup) 429.	
<b>Curtis ... lifetime</b>	
1681 Curtis Clip CC-1 .....	6.
1686 Disk Holder DB-1 .....	8.
1718 3 1/2" Disk Holder DB-2 .....	8.
1704 Printer Stand PS-1 .....	18.
1713 Filtered SafeStrip SPF-3 .....	24.
1694 Emerald SP-2 .....	36.
1707 Ruby SPF-2 (6 outlets; EM/RFI filtered; 6 ft cord) .....	55.
1708 Ruby-Plus SPF-2 Plus (w/FAX & modem protection) .....	65.
<b>DecEasy ... 1 year</b>	
<b>ACCELERATORS</b>	
3211 Breakthru 286-8 (8 MHz) .....	225.
3210 Breakthru 286-12 (12 MHz) .....	349.
<b>Epson ... 1 year</b>	
Epson are an authorized Epson Service Center	
1906 FX-850 (80 col., 264 cps, 9 pin) .....	call
1904 FX-1050 (136 col., 264 cps, 9 pin) .....	call
5183 LQ-510 (80 col., 180 cps, 24 pin) .....	349.
1930 LQ-850 (80 col., 264 cps, 24 pin) .....	call
4117 LQ-850 (110 col., 220 cps, 24 pin) .....	call
1917 LQ-1050 (136 col., 264 cps, 24 pin) .....	call
4116 LQ-2550 (136 col., 333 cps, 24 pin) .....	call
5184 LX-810 (80 col., 180 cps, 9 pin) .....	199.
1052 Printer-to-IBM cable (6 feet) .....	15.
We carry a full line of Epson accessories and ribbons. Call us with your needs.	
<b>5th Generation ... 1 year</b>	
3952 Logical Connection 512k .....	529.
4921 Logical Connection 1 Meg .....	659.
<b>Hayes ... 2 years</b>	
2304 Smartmodem 1200 .....	289.
2305 Smartmodem 1200B (w/Smartcom II) 289.	
2306 Smartmodem 1200B (hardware only) 259.	
2307 Smartmodem 2400 .....	429.
2308 Smartmodem 2400B (w/Smartcom II) 429.	
2309 Smartmodem 2400B (hardware only) 399.	



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## Hercules ... 2 years

2318	Graphics Card Plus .....	\$189.
5120	VGA Card .....	189.

## Intel ... 5 years

4696	2400B Internal Modem .....	159.
2352	2400B Internal Modem 2 (for PS/2) .....	249.
5119	2400B External Modem .....	179.
2346	Inboard 386/PC w/1 Meg .....	599.
4646	Inboard 386/PC Piggyback 4 Meg .....	1249.
2339	Inboard 386/AT (req. inst. kit) .....	859.
2338	Inboard 386/AT Installation Kit .....	139.
4266	Above Board Plus 512k .....	419.
4267	Above Board Plus I/O 512k .....	449.
5336	Above Board Plus 8 2 Meg .....	699.
5342	Above Board Plus 8 I/O 2 Meg .....	739.
4272	Above Board 2 Plus 512k .....	469.
4339	Above Board Plus Piggyback w/2 Meg (upgrades to 4 Meg) .....	call

4275	Connection Coprocessor .....	769.
4857	Visual Edge (improve the output of your HP Laserjet II) .....	449.

## MATH COPROCESSORS

2374	8087-2 (for 8 MHz 8088 CPU's) .....	129.
2368	80287 (for 6 MHz 80286 CPU's) .....	135.
2370	80287-8 (for 8 MHz 80286 CPU's) .....	199.
2369	80287-10 (for PS/2 Models 50 & 60) .....	229.
4750	80387SX (for 80386SX CPU's) .....	309.
2371	80387 (for 16 MHz 80386 CPU's) .....	349.
2372	80387-20 (for 20 MHz 80386 CPU's) .....	399.
4121	80387-25 (for 25 MHz 80386 CPU's) .....	499.



## Software Publishing ... NCP

©Harvard Graphics 2.0—Be "free and easy" with the industry's best-selling presentation graphics package. Now with a coupon for free drawing accessory (normally \$149 List). Graphically the best choice ... \$299.

## Kenallington Microware ... 1 year

2581	Masterpiece .....	94.
2582	Masterpiece Plus .....	109.
4972	PowerTree 10 .....	19.
4973	PowerTree 20 .....	27.
4974	PowerTree 50 .....	49.
5697	Expert Mouse (Trackball for PS/2) .....	115.

## Keytronic ... 3 years

2537	101 Keyboard .....	99.
4518	101 Plus Keyboard .....	99.

## Kraft ... 5 years

5800	3 button Thunder Joystick .....	29.
5813	ThunderStick w/new game adapter .....	55.
4292	3 button Joystick w/game adapter .....	45.



## Intel ... 5 years

Inboard 386/PC—Boost your PC performance. A 16MHz 80386 processor and 1Mb RAM allows you to handle today's most advanced applications, including Lotus 1-2-3 Release 3. 30 day money back guarantee. ... \$599.

5801	New Game Adapter (2 game ports) .....	27.
5802	Trackball .....	69.

## Logitech ... limited lifetime

5464	Series 2 Mouse (C9 for PS/2's) .....	65.
4388	ClearCase Mouse (serial only) .....	65.
5151	HIREZ Mouse (C3) .....	85.
5152	Mouse w/Point Show (C9) .....	99.
4297	ScanMan Plus (hand scanner) .....	185.

## Magnavox ... 2 years

4758	13" VGA Monitor (8CM515) .....	269.
4760	13" Hi-Res Monitor (9CM053) .....	369.
4761	13" VGA Monitor (9CM062) .....	389.
4762	13" VGA Monitor (9CM082) .....	449.

## Micron Technology ... 2 years

5818	Beyond 640 EMS Board 1 MB (exp. to 8 MB w/dalughter card) .....	369.
5821	Beyond EX Extended Memory Board 2 MB (exp. to 4 MB w/dalughter card) .....	599.

## Microsoft ... lifetime

2870	Mac 20 (1 year warranty) .....	349.
2897	Mouse with Paintbrush .....	109.
2896	Mouse with Easy CAD .....	125.
2898	Mouse with Windows 286 2.1 .....	139.

## Mouse Systems ... lifetime

2812	OmniMouse (serial only; 1 year wty) .....	39.
4306	PC Mouse II w/PC Paint+ .....	89.

## NEC ... 2 years

4799	Multisync 2A (VGA Monitor) .....	499.
5085	Multisync 3-D Monitor .....	689.

## Orchid Technologies ... 4 years

3069	Tiny Turbo 286 (accelerator board) .....	219.
4765	Designer 800 VGA (360 x 480) .....	159.
4690	ProDesigner VGA (800 x 600) .....	249.

## PC Power & Cooling Sys. ... 1 yr

## REPLACEMENT POWER SUPPLIES

3202	Turbo Cool 150 (25° - 40° cooler) .....	129.
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3205	Turbo Cool 250 (25° - 30° cooler) .....	\$169.
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3200	Silencer 150 (84% noise reduction) .....	115.
4514	Turbo Cool 375 .....	299.

## Practical Peripherals ... 5 years

3101	1200 Baud Internal Modem .....	69.
3100	1200 Baud External Modem (mini) .....	77.
3097	Microbuffer Inline (par. print buffer/32k) .....	135.
3103	2400 Baud Internal Modem .....	139.
3102	2400 Baud External Modem .....	179.
5285	2400 Baud Ext. MNP Modem (Luv 5) .....	209.
4542	2400 Baud Internal Modem for PS/2 .....	229.

## Princeton Graphics ... 1 year

3166	Ultrasync (800 x 600 max. res.) .....	549.
5143	Quadram ... 1 year JTFAX 9600 .....	549.

## Safe Power Systems ... 2 years

4561	Safe 250W (standby power bkup) .....	249.
4562	Safe 425W (standby power bkup) .....	369.
4563	Safe 500W (standby power bkup) .....	495.

## SOTA Technology ... 2 years

5107	Floppy Drive Controller (S/P) .....	99.
5109	SOTA VGA/16 (with 256k) .....	219.
5111	SOTA 286i-12 (16 MHz accelerator) .....	299.
5402	SOTA 386i-16 (16 MHz accelerator) .....	419.

## Targus ... lifetime

4899	Nylon Laptop carrying case .....	55.
4901	Leather Laptop carrying case .....	139.

## TheComplete PC ... 2 years

4889	TheComplete Hand Scanner 400 .....	159.
5598	TheComplete Hat. Pg. Scanner 400 .....	189.
4887	TheComplete FAX 9600 .....	429.
5140	TheComplete Page Scanner .....	549.

## OCR SOFTWARE

5789	TheComplete OCR/HIS 1.0 .....	199.
5807	TheComplete OCR/Page 1.0 .....	319.

## Toshiba ... 1 year

3684	T1000 Laptop (80C88, 6.4 lbs.) .....	669.
4856	T3100E Laptop (12 MHz, 20 Meg) .....	2749.
4958	T1600 Laptop (12 MHz, 20 Meg) .....	3249.

## Video 7 ... 5 years

3778	VEGA VGA .....	259.
4193	FastWrite VGA (includes 256k) .....	319.
4194	VRAM VGA (includes 256k) .....	469.



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<b>IOmega ... 1 year</b>	
2485 Bernoulli II Single 20 Meg Internal	\$767.
5116 Bernoulli II Single 44 Meg Internal	995.
2486 Bernoulli II Dual 20 Meg External	1659.
5117 Bernoulli II Dual 44 Meg External	1969.
4276 20 Meg Cartridge Tripak (5 1/4")	169.
5113 44 Meg Cartridge Tripak (5 1/4")	249.
<b>CONTROLLERS (required)</b>	
2499 PC2 Card	169.
2500 PC2B Card (bootable card for PC/XT/AT)	229.
2502 PC4 Card (for PS/2 Model 50/60/70/80)	299.
<b>Mountain Computer ... 1 year</b>	
2917 40 Meg Internal Tape Drive	379.
2915 40 Meg External Tape Drive	479.
2916 40 Meg External Tape Drive with Power Supply	569.
5378 60 Meg External Tape Drive with Power Supply	1169.
5616 150 Meg External Tape Drive with Power Supply	1495.
5499 80 Meg Internal Tape Drive	519.
5503 80 Meg External Tape Drive	629.
5190 40 Meg Data Cartridges (pre-formatted)	35.
<b>Pacific Rim ... 1 year</b>	
5010 1.2 Meg External (for PS/2's)	215.
5011 360k External 5 1/4" Drive	179.
<b>Plus Development ... 2 years</b>	
3105 Hardcard 20 Meg (49 ms)	549.
3106 Hardcard 40 Meg (28 ms)	699.
<b>Seagate ... 1 year</b>	
<b>FREE PCTV® Hard Drive Installation</b>	
Tape with purchase of 20, 30 or 40 Meg	
Seagate drive for the IBM PC (not for AT). Beta or VHS.	
2285 20 Meg Internal Hard Drive ST225 (w/controller and cables, 65 ms)	289.
2286 30 Meg Internal Hard Drive ST238 (w/controller and cables, 65 ms)	299.
4554 40 Meg Int. HD ST251-1 (28 ms)	359.

2287 40 Meg Int. HD for PC 251-1 (w/controller and cables, 28 ms)	\$435.
4624 80 Meg Int. HD ST4096 (28 ms)	619.
<b>TEAC ... 1 year</b>	
4950 PC, XT 360k Drive (5 1/4")	79.
4951 720k Drive (specify XT or AT, 3 1/2")	79.
4670 1.44 Meg Drive for XT (3 1/2")	99.
4326 1.44 Meg Drive for AT (includes Bastech software utilities, 3 1/2" copy prot.)	119.
<b>Toshiba ... 1 year</b>	
3650 AT 360k Drive (5 1/4")	85.
3649 AT 1.2 Meg Drive (5 1/4")	99.
4755 AT 1.44 Meg Drive (3 1/2", includes Bastech software utilities)	119.

## MISCELLANEOUS

<b>CompuServe</b>	
1676 CompuServe Information Service	24.
<b>Cables ... lifetime</b>	
1019 Smartmodem-to-AT cable (10 feet)	15.
1050 Parallel Printer cable (15 feet)	19.



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3248 256k DRAMs (120 nanosecond)	call
4366 1 Meg x 9 SIMMs (100 nanosecond)	call
5510 1 Meg x 9 SIMMs (80 nanosecond)	call
5746 1 Meg Chips (80 nanosecond)	call

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- Continental US:**
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  - For all other items, add \$3 per box to cover UPS Shipping. For such items, we automatically use UPS 2nd-Day-Air at no extra charge if you are more than 2 days from us by UPS ground.
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<b>5 1/4" DS/DD Disks (360k)</b>	
3291 Sony (10 disks per box)	12.
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# PC CONNECTION

# PRINTERS MONOCHROME DOT MATRIX

3410XLQ managed a respectable 150 cps in draft mode and 82 cps in NLQ mode. It printed the halftone image in 55 seconds.

Alas, the print quality is tepid at best. Draft-quality text is acceptably dark, but the individual letters are ragged enough to make you want reading glasses. So-called letter-quality output is more readable, with darker print and reasonably solid characters, but the typeface is still difficult to read. The lowercase *s*, for example, looks almost like an 8. Similarly, the wide branches of the *y*'s and *w*'s tend to close in, so that they almost touch.

Graphics print quality fares better in some ways, with dark areas being solidly black and patterns maintaining a noticeable crispness. As with other 9-pin printers, the most detailed patterns on PC Labs graphics test became solid black.

A far worse problem with graphics is that the IBM Proprinter emulation has a serious flaw. The 3410XLQ uses 1/32 inch for its minimum horizontal graphics movement, compared with the Proprinter's 1/64 inch. This yields a change in aspect ratio, squashing the graphic in the horizontal direction. Worse, if an application determines spacing by a combination of graphics spacing and nongraphics spacing, this

can throw off the alignment. On the PC Labs test, this flaw shifted the bottom one-fifth of the scanned photo over by about one-half inch from the rest of the graphic. On the plus side, the printer obeyed the Proprinter text commands in the fonts and features test.

Not so incidentally, the *Q* in the 3410XLQ's name stands for *Quiet*. Alas, the *Q* is hard to justify. With a measured noise level of 75 decibels, the printer is not overly noisy, but it's not notably quiet either. According to Genicom, the company also sells a 3410XLS, which is the same printer without the sound enclosure (and thus presumably noisier), for \$2,010. There is also a color version and a bar-code version.

There is one last flaw here: no thought has been given to making the printer easy to use. For example, the 2-character LED boasts a repertoire of 27 cryptic status displays (such as SE, SU, and S.b) and another 17 equally cryptic error messages. These are explained in the manual, but if you lose the manual you're in deep trouble. It's no exaggeration to state that this printer's command design is user-hostile.

The Genicom 3410XLQ has more going against it than for it. If you're interested in printing a lot of moderately readable text with little chance of paper jams, the 3410XLQ may be of some interest. But if you want graphics or letter-quality output, or even an easy-to-use printer, this is not the one to get.

## Genicom 3820

by M. David Stone

The Genicom 3820 is the kind of printer you buy when you're very serious about printing. Standing 12.1 inches tall at its highest point, with a footprint of 14.75 by 26.75 inches, and sporting a front panel that would look at home on the bridge of the Starship *Enterprise*, this \$2,475 printer is one of the more-imposing dot matrix beasts ever to come through PC Labs.

In terms of both speed and print quality, the 3820 performed well. On the PC Labs text speed tests, draft mode clocked in at about 235 characters per second, a pretty good clip by any standard; NLQ mode managed an impressive 104 cps. As for print quality, draft output on the 3820 is reasonably dark and readable—thanks in part to the 18-pin printhead, but also to a well-designed typeface. You might not

want to read 40 pages in one sitting, but the text is at least serviceable. NLQ output is something Genicom can boast about. The text is dark and crisp, with solid—nearly Selectric-quality—characters. You have to look closely to see that it came from a dot matrix printer.

Graphics speed and quality vary greatly, depending on the emulation you're using. In Proprinter mode, the graphics output is a match for any 9-pin Proprinter

### Genicom 3820 Fonts & Features

#### IBM Proprinter 9-pin

	bold	italic	Sub Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

#### Epson FX

	bold	italic	Sub Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

emulation you can find. Filled-in areas are solid black, and large patterns retain their detail. Small patterns are almost solid, as is typical. The scanned photograph in the PC Labs graphics test had a slightly posterized effect but retained as much detail as the emulation allows. The test took about 34 seconds.

Alas, the printer's FX-286e graphics emulation has problems. The most important is that some horizontal passes are slightly offset from others, so that vertical lines are ragged. Also, the printer is substantially slower in FX mode, with a time on PC Labs' tests of about 66 seconds. It's best to limit the FX emulation to text or ignore it entirely.

Paper handling is one of the real strengths of the 3820. If you like flexibility, you'll appreciate the four paper paths, which offer rear, bottom, front, and top feed. As shipped, the printer includes one set of push tractors for the rear slot. You can remove these, reinstall them in the front, and use them for either the front-feed path or the bottom-feed straight-

### GENICOM 3410XLQ



### PC FACT FILE

Genicom Corp., Genicom Dr., Waynesboro, VA 22990, (800) 535-4364, (703) 949-1000  
List Price: \$2,175

Dimensions (HWD): 7.2 x 25.25 x 19 in.

Weight: 43 lbs

Emulations: IBM Proprinter, ANSI

In Short: The Genicom 3410XLQ has more disadvantages than advantages. If you want to print a lot of moderately readable text with little chance of paper jams, the 3410XLQ may be of some interest. But this one provides poor letter-quality output, and it's not even easy to use.

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## MONOCHROME DOT MATRIX

through path. The top paper path is for single-sheet feed.

A particularly nice touch is that you can buy a second tractor for \$125 and install one in the back and one in the front. This lets you set up the printer with, for example, heavy stock labels loaded through the bottom-feed tractor and wide-carriage paper on the rear-feed one. Since both tractor positions have a park feature, you can have both kinds of stock loaded and available at all times. A tear-off feature for the tractor-feed paper complements the paper handling nicely.

Setting up is a little more complicated with the 3820 than with most printers, but not difficult enough to be troublesome. The preliminary manual provided with the review unit won't win any awards for its writing style or organization, but it has all of the information you need and is short enough to encourage a read-through. A second manual includes the control codes for both ANSI and IBM Proprinter emulations. The only information on the FX emulation, however, was in an easily lost errata sheet.

The printer's front panel harbors an unusual number of controls and indicator lights: 14 membrane switches and 16 lights. But don't worry—the controls are

straightforward. One warning, though—this printer is loud (82 decibels). The noise is not overly bothersome for text, but you'll probably want to leave the room if you're printing graphics. In several years of testing printers, this is the first printer that's driven me to hold my hands over my ears.

With the exception of the noise quality on graphics, the noteworthy features of the Genicom 3820 fall almost entirely in the plus column. The unit's problem with FX graphics is annoying but easy to ignore, since you should be able to use the Proprinter mode with virtually any software. The price, of course, is well into laser printer territory, but you won't get this kind of paper handling in a laser printer. The Genicom 3820 has so much to recommend it that you may be willing to forgive its few flaws.

## Hyundai HDP-910 Hyundai HDP-920

by Robin Raskin

While the stars of Hyundai's dot matrix printer lineup are its 18-pin HDP-1810 and 1820 printers, these 9-pin printers offer solid performance at a low price. The print quality for both the \$259 HDP-910 narrow-body printer and the \$349 HDP-920 wide-carriage printer is admirable for 9-pin machines. The design, while not especially innovative, is clean and efficient. Hyundai acquired the technology for this line of printers from Canon when Canon withdrew its products from the dot matrix market.

The printers emulate either the Epson FX or IBM Graphics Printer via a single DIP-switch setting. Three banks of DIP switches are located beneath a plastic coverplate, underneath the paper path, in the bowels of the printer. You must remove the paper from the printer to get at the switches, but once this is done, the DIP switches are easy to get at. Both Epson and IBM Graphics Printer graphics emulations worked well, and we were able to access both high-order character sets using standard escape sequences. Unfortunately, the printers do not emulate the IBM Graphics text, only the Epson text.

In Epson FX emulation, the 910 and 920 clocked in acceptable speeds of 52 and 54 characters per second on our tests. In

IBM Graphics mode, they handled the scanned photo test in 35 and 37 seconds, respectively.

The printers' draft mode is a standard 11- by 9-dot matrix. NLQ increases the matrix to 23 by 18 dots. Draft mode uses a bidirectional high-speed printhead motion; NLQ does a double pass on each line of

Hyundai HDP-920

### Fonts & Features

	Epson FX			
	Bold	Italic	Sub Super	Underline
10 cpi	Yes	Yes	Yes	Yes
12 cpi	Yes	Yes	Yes	Yes
Compressed	Yes	Yes	Yes	Yes
Proportional	Yes	Yes	Yes	Yes

text. The 910 prints 80 characters per line, and the 920 prints a hefty 156 characters (in 10-character-per-inch mode). The print quality in both draft and NLQ is solid, with well-formed characters. But the printers' real strength is in graphics; the graphics output has an even density, with crisp, defined objects.

The card-deck-size ribbon cartridge nestles into the right-hand side of the printer, just below the front cover. The ribbon is manually pulled from the cartridge's casing and stretched harmonica-style across the width of the machine, creating a giant loop. I call this technique the Dick Tracy special, since my inky fingerprints were left everywhere on the printer during the process. Hyundai should include plastic gloves or use the more-tidy clamshell ribbon design.

The HDP-910 and HDP-920 have identical front panels that offer a minimalistic but convenient duo of membrane keys to toggle between draft and NLQ print. The control panel also sports three indicator lights: On-Line, Alarm, and Ready. Unfortunately, there is no indicator light to tell you whether you are in draft or NLQ mode. This omission is one of the printers' biggest shortcomings.

The paper-handling mechanisms for both of these printers are rudimentary rear-feed/pin-feed mechanisms, but the paper never jammed. There are slight differences in paper handling between the narrow- and wide-carriage printers. The paper-release lever on the wide model has a paper-out detector—a handy item that should be in-

#### GENICOM 3820



#### FACT FILE

Genicom Corp., Genicom Dr., Waynesboro, VA 22980; (800) 535-4364, (703) 949-1000.

List Price: \$2,475

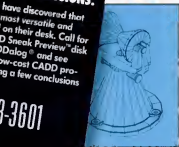
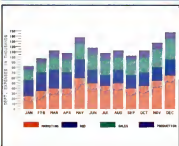
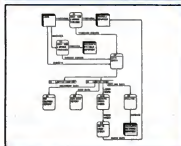
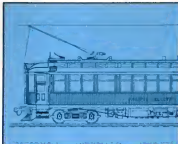
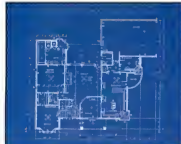
Dimensions (HWD): 12.1 x 26.75 x 14.75 in.

Weight: 52 lbs.

Emulations: IBM Proprinter (9-pin), Epson FX, ANSI

In Short: For graphics, stick with the Proprinter mode on the Genicom 3820. This printer is pricey, but you can't get its sophisticated paper handling in a laser printer. The 3820 has so much in its favor that you may be willing to overlook its few snags.

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# PRINTERS MONOCHROME DOT MATRIX

cluded on both models. Only the 80-column printer has a Cut Sheet switch that you toggle when choosing between cut-sheet and fanfold paper. Both printers sport a paper-release lever with three settings clearly marked in English: Paper Set, Pin Feed, and Friction Feed. I find this use of English labels far more helpful than the icons on many dot matrix printers.

Both printers both offer Pica, Elite, and Italic typefaces with a fair but not overwhelming number of print and format enhancements. The printers can handle doublestrike, subscript and superscript, and underline, but they can't manage format enhancements such as justification or centering. Both units offer 11 international character sets, as well as two downloadable fonts (Gothic and Courier) for only \$13.50 each.

The 910 and 920 will accommodate three-part forms and cardboard stock without any problems. A five-position paper-thickness lever, housed just under the front cover, lets you make necessary adjustments in distancing the printhead.

The absence of paper park, automatic paper feed, and other innovative dot ma-

trix features keeps Hyundai's costs way down. You are relegated to performing much of the paper handling manually, like switching between continuous-form and cut-sheet paper, aligning and advancing the paper, and so forth.

Hyundai's 9-pin repertoire offers good-quality type at rock-bottom prices. But there's reason to consider paying a little bit more. Hyundai's 18-pin printers, for a moderate additional sum, offer better print quality and have a few more features that might make all the difference.

## Hyundai HDP-1810 Hyundai HDP-1820

by Robin Raskin

It's only natural for Hyundai to make a series of dot matrix printers that offer solid performance but are uncluttered by excessive frills and gadgetry. And it stands to reason that these printers would sell at tempting prices. After all, Hyundai, that Korean wunderkind of manufacturing, applies the same principles to building printers that its parent company does with cars. But the truth behind the deal is that Hyundai purchased the printer technology for the \$399 Hyundai HDP-1810 and the \$519 Hyundai HDP-1820 from Canon after Canon discontinued the line.

The 1810 and 1820 are the narrow- and wide-carriage versions, respectively, of an adept 18-pin printer. Both models offer three basic text modes: draft, NLQ, and NLQ Plus, all selectable from the front-panel membrane-key control pad. The draft type offers reasonably well-formed characters and uses a moderately fast bidirectional printhead motion. NLQ printing results in a solidly formed font, but you'll find that the speed of the printer nosedives as the printhead moves in a unidirectional fashion.

NLQ Plus is an attractive, high-quality typeface that is achieved when the printhead makes a double pass over each line of type. The results are pretty, but the process is slow.

Hyundai takes a modular approach to printer building. You can choose between the standard parallel or optional serial interface control card. You can also select either an Epson FX or IBM Graphics Printer emulation card. Whichever you choose, both cards are slipped into a rear compart-

ment of the printer, which houses separate slots for each card. The control card is factory installed; the emulation card requires installation. We tested the parallel interface and the Epson emulation, which Hyundai considers the basic configuration.

The base unit has a small footprint and a clean, uncluttered—although not especially innovative—design. The most striking feature of the printer is the large-buttoned control panel located on the front right-hand side of the machine. The membrane key on the panel let you choose among the three available text modes. Unlike some of the more-complicated dot matrix printers, which ask you to change text mode by banging out a series of keypresses, Hyundai text-mode selections are straightforward. The control panel also has a pitch selector that toggles through the printer's various pitch settings (10, 12, or 17 characters per inch or proportional).

The printer has no built-in fonts and will not operate without a slim font cartridge inserted into a slot on the lower front panel. If no cartridge is detected, the printer's warning alarm sounds. Both machines come standard with a single Courier font cartridge. The font emphasizes those Courier-type serif embellishments that make for a boxy look, but it's certainly clear and easily legible. Hyundai sells a handful of optional font cartridges (seven cartridges

## Hyundai HDP-1820 Fonts & Features

Epson FX					
		Bold	Italic	Sub-Super	Underline
10 cpi	Compressed				
12 cpi	Proportional				

with one font per cartridge) for \$33.50 each.

The printer's paper-handling features are spartan but work flawlessly. Paper handling is relegated to a pin-feed tractor that pulls the paper in from the rear in traditional "U" fashion. A simple three-way paper-release lever on the top of the printer lets you move the printer bale into position to set and adjust the paper. The pin-feed sprocket mechanism has just the right touch—not too stiff but not too much play.

### HYUNDAI HDP-910 HYUNDAI HDP-920




### PC FACT FILE

Hyundai Electronics America, 166 Baypointe Pkwy., San Jose, CA 95134; (408) 473-9200.  
List Price: HDP-910, \$259; HDP-920, \$349.  
Dimensions (HWD): HDP-910, 4.3 x 17 x 12.7 in.; HDP-920, 5.1 x 24.9 x 13.8 in.  
Weight: HDP-910, 17.6 lbs.; HDP-920, 22 lbs.  
Emulations: Epson FX Series, IBM Graphics Printer.

In Short: These bare-bones 9-pin printers, which include DIP-switch settings for both Epson FX and IBM Graphics emulations, won't win any awards for design innovation or special features, but the print quality is exceptionally good and the paper flow is smooth. However, Hyundai's 18-pin printers are the better bargain.

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HYUNDAI HDP-1810  
HYUNDAI HDP-1820

## FACT FILE

Hyundai Electronics America, 166 Baypointe Pkwy., San Jose, CA 95134, (408) 473-9200  
**List Price:** HDP-1810, \$399; HDP-1820, \$519.  
**Dimensions (HWD):** HDP-1810, 3.9 x 16 x 12.2 in.; HDP-1820, 4 x 22.7 x 12.2 in.  
**Weight:** HDP-1810, 13.7 lbs.; HDP-1820, 16.7 lbs.  
**Emulations:** Epson FX Series and IBM Graphics Printer (both require control cards).  
**In Short:** These 18-pin printers from Hyundai offer better-looking text than many 24-pin printers, and at a lower cost. They come standard with built-in draft, NLO, and NLO Plus print modes but require a built-in font cartridge (Counor is supplied). No frills or gadgetry, but nice output.

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Both printers will accommodate three-part forms and cardboard stock without any problems. A five-position paper-thickness lever, housed just under the front cover, lets you make necessary adjustments in distancing the printhead.

The narrow- and wide-body versions have slightly different paper-handling arrangements. The narrow 1810 has a built-in pin-feed mechanism for moving continuous-form paper; in contrast, it handles single sheets by feeding them typewriter-style around the carriage.

The wider 1820 has no internal pin-feed mechanism. Instead, a simple external pin-feed tractor unit is installed to handle continuous-form paper. It's a good thing installation proved so easy, because the documentation (which is identical for both printers) doesn't have a word about the tractor feed or its installation. In addition to their overall dimensions, other differences between the narrow- and wide-body printers include the 4K buffer found in the 1810 versus the 8K buffer in the 1820.

Print speed, rated at a blazing 300 characters per second by the manufacturer, was less impressive during our tests—87 cps

on the narrow carriage. The characters print quickly enough, but the paper advance from one sheet to the next seems very slow.

Both printers performed very well in the graphics tests, skillfully emulating both the IBM Graphics Printer and the Epson FX series printers. The Epson-emulation graphics were the better of the two types: well detailed, even-toned, and sharp.

Some complaints about these printers fall into the nit-picky category. For example, it's impossible to remove the packing tape from the printhead and cover without leaving a sticky film and tape threads all over the printer. Ribbons are also just adequate. The printer ribbon on the 1810 jammed up after a few thousand characters during testing, and the belt mechanism might spell trouble in the long run. The skinny belt on the 1810 had thin patches where the metallic threads beneath the rubber poked through.

Overall, this duo from Hyundai looks good. Lightweight, light price, good print quality, and no operational snafus. If you like 'em sparse and pretty, Hyundai's 18-pin printers get the nod.

## IBM Proprinter X24E IBM Proprinter XL24E

by Robin Raskin

The IBM Proprinter line has carved a deep niche in the dot matrix world. The \$899 IBM Proprinter X24E, a narrow-carriage printer for forms up to 11 inches wide, and the \$1,199 XL24E, a wide-carriage machine for forms up to 16.5 inches wide, are revamped versions of the IBM Proprinter 4207 and 4208 Model I, first introduced in April 1987.

The verdict? The print quality is excellent, the graphics quality a tad less than excellent, and the paper-handling features so distinctive that you'll either love 'em or leave 'em. And in a world where dot matrix prices are plummeting, IBM's Proprinters are still expensive.

The Proprinter line is loaded with personality. Its trademarks are an impressive front panel, a top-of-its-class Propark feature, a bevy of musical tones to provide user feedback, and a highly automated paper-feed mechanism. All of these features eliminate the hands-on muss of many dot

matrix printers, but they also require a bit more user know-how to really take full advantage of them. Don't lose the excellent manual.

The printers are shipped from the factory with the ribbon installed and ready to go. While I applaud the sentiment, I wonder about the long-term efficacy. If you're

**All you need to do is  
lift the cover of the  
Proprinter to see what  
you're paying for.**

going to have trouble installing a ribbon in your printer, you might as well have trouble on day 1, and not 6 months later.

The original Proprinter was the first dot matrix to let you print on fanfold and cut-sheet forms without removing the fanfold paper. The Proprinter X24E and XL24E continue the tradition with their flawless Propark feature. When you press a single Propark key on the front panel, the fanfold paper is retracted from the paper path, making way for the front-fed single-sheet paper. My only minuscule complaint is that, when peering over my printer, I would accidentally brush the Propark button and unintentionally set the gears in motion.

Paper-handling features abound on these new Proprinters. At the top of the list is the Paper-Load Assist function for continuous forms. You might as well throw away the paper-advance knob on the printer because you'll never need to use it. To load fanfold paper, you simply press the Feed key on the front panel. This starts up the pin-feed motor and slowly advances the knob. Your fanfold paper catches in the pin feeds as you insert it. The rest of the paper load is entirely automatic. In addition, a tear-assist bar lets you tear the form at the perforation without having to advance the paper past the top of the next form—a welcome feature.

Single sheets are friction-fed into the front of the printer. Ed Clark, product manager for the Proprinter line, tells me that the *E* in the printer's title stands for "enhanced," but it could just as well stand for "envelopes," which can be fed easily

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### COMPARE FOR YOURSELF

Feature	AST Premium 386SX/16	COMPAQ DESQPRO® 386s	COMPAQ DESQPRO® 286s	IBM® PS/2™ Model 55
Processor				
Type	386SX	386SX	286	386SX
Speed	16 MHz	16 MHz	12 MHz	16 MHz
Available Slots	5	4	4	3
EMS Support				
Software Included	4.0	3.2	4.0	No
Landmark Benchmarks*	23.1	15.4	11.8	15.3
List Price** One-Floppy System	\$2,895	\$3,290	\$2,890	\$3,895***

\* Landmark Software version 1.1 benchmarks — a generalized index used to compare one machine to another. The higher the number, the better.

\*\* List price is MSRP.

\*\*\* List price with 30 MB hard drive, one-floppy system not available with this model.

So, if you're considering an 80286- or 80386SX-based computer from a manufacturer like Compaq® or IBM®, make sure you compare it to the AST Premium 386SX/16. After all, if your needs require a workhorse, shouldn't you buy a thoroughbred?

**AST**  
RESEARCH INC.

CIRCLE 736 ON READER SERVICE CARD

# PRINTERS MONOCHROME DOT MATRIX

## IBM PROPRINTER X24E IBM PROPRINTER XL24E



## PC FACT FILE EDITOR'S CHOICE

IBM Corp., Old Orchard Road, Armonk, NY 10504; 800-425-2468.  
List Price: Proprinter X24E, \$899; XL24E, \$1,199.  
Dimensions (HWD): Proprinter X24E, 5.25 x 16 x 13.5 in.; XL24E, 5.25 x 22 x 13.5 in.  
Weight: Proprinter X24E, 20 lbs.; XL24E, 25 lbs.  
Emulations: IBM Proprinter (24-pin)  
In Short: These enhanced 24-pin IBM Proprinters are a welcome addition to the Proprinter line. They offer some wonderful paper-handling capabilities, including their excellent Propark feature, an automatic paper-loading function, and a surefire envelope feed. The front-panel keypad controls print enhancements and features, but the use of musical tones and not LCD panels as the user-feedback mechanism is a bit passé. The text quality is excellent, but not the best choice for graphics.

CIRCLE 627 ON READER SERVICE CARD

into the front of the printer. An Envelope setting on the forms-thickness lever makes certain the printhead is optimized for envelopes. The printer also handles four-part forms admirably, but the manual specifically cautions you against using cardboard stock.

The Feed key on the front panel advances the paper a single line at a time or a half page at a time, but there is no Form Feed key. My only reservation about the paper feed is that the push-tractor method used catches the paper before it goes around the platen. There is nothing holding the paper taut when it comes around the platen and meets the printhead.

The Proprinter sings, literally. It uses a series of musical tones to inform you of the printer's status. For example, the printer plays a three-tone sequence eight times when it's out of paper. Once you develop an ear for printers, the system does the trick, although an LCD display panel might be more helpful.

Another interesting feature is the use of front-panel key sequences to select printing modes and replace dreaded DIP-switch adjustments. To enter the Setup mode, you turn the printer on with the On-Line and Propark keys depressed. You can then activate emphasized, double-high, or double-wide print by pressing Propark a specific number of times. Using a slightly different set of front-panel keypresses, you can toggle printer features such as a slashed zero, an alternative character set, and line length. This sure beats having to mess with DIP-switch settings.

But when you change Setup, the only feedback you get is the series of musical tones; when you change printer features, you get a graphical printout of your active selections. Some other printers have incorporated similar technologies but offer LCD displays, providing less-cryptic feedback.

The Proprinter comes stocked with

data-processing-style draft, 10-point Courier, Prestige Elite, and proportional Courier fonts. All of the fonts are handsomely formed and make good use of the 24-pin technology. An optional Font Set, containing 11 other fonts (including italics) and an EPROM are available for \$114. The printers are rated at 240 characters per second in draft mode, but our tests showed the wide-carriage printer to operate at 159 cps and the narrow-carriage model at 100 cps. While the gap between the actual and the claimed speeds is large, the draft mode is still very fast.

Graphics printing is not quite up to par. Some odd quirk in the printer makes it miss an occasional line of the graphic and then print the following line as a double-strike. Also, the Epson LQ emulation was not quite right. On the wide-carriage printer our scanned image graphic was elongated, and on the narrow-carriage printer the scanned image graphic was mysteriously

framed with the letter M. The printer is IBM Graphics Printer compatible. The bottom line is that these Proprinters are better for text than graphics.

All you need to do is lift the cover of the Proprinter to see what you're paying for. The workmanship is solid and impressive. Every detail—from the heavy-duty screw mechanism to the pin-feed sprockets, the paper-release mechanisms, the printhead motor, and the circuit board itself—seems built to last. All told, the X24E Proprinter series is a good choice for anyone who needs dot matrix printers that can handle the various and sundry tasks of the office environment.

## Laser 190E

by David M. Stanton

Laser Computer, a division of Video Technology Corp., offers an acceptable but not exceptional printer in the \$370 Laser 190E. The unit includes typeface enhancements not included with its larger and more expensive counterpart, the Laser 240, but the 190E's documentation and Laser Computer's knowledge of its product leave something to be desired.

The Laser Computer name may be familiar to Apple-oriented folks, as the company offers a popular Apple-compatible computer. The 190E, which is manufactured by Nakajima and has an Apple-compatible twin (the Laser 190A), is available for as little as \$209 from dealers that advertise in Apple specialty magazines.

The 190E operates specifically in Epson FX-85 and IBM Graphics Printer modes. This basic fact was difficult to nail down because Laser Computer first told us that its manual, which specifies the above modes, was wrong and that the 190E does accept IBM Proprinter emulation. We then found that the 190E did not pass the IBM Proprinter test.

## IBM Proprinter XL24E Fonts & Features

IBM Proprinter X24E			
	Bold	Italic	Sub-Script
10 cpi	■	■	■
12 cpi	■	■	■
Compressed	■	■	■
Proportional	■	■	■

## Laser 190E Fonts & Features

Epson FX			
	Bold	Italic	Sub-Script
10 cpi	■	■	■
12 cpi	■	■	■
Compressed	■	■	■
Proportional	■	■	■

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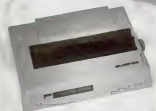
	AST Premium 386/33	COMPAQ DESKPRO® 386/33
CPU speed	Excellent	Excellent
Expandability	Excellent	Excellent
Hardware compatibility	Excellent	Excellent
Documentation	Excellent	Good
Technical support	Very Good	Unacceptable
Value	Good	Satisfactory
Final Scores	8.5	7.1

Source: InfoWorld, July 24, 1989

**AST**  
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CIRCLE 539 ON READER SERVICE CARD

## LASER 190E



## FACT FILE

Laser Computer Inc., 550 E. Main St., Lake Zurich, IL 60047-2576, (312) 540-8335  
List Price: \$370

Dimensions (HWD): 3 6 x 16.5 x 13.75 in.

Weight: 14 lbs.

Emulations: Epson FX-85, IBM Graphics Printer  
In Short: A printer with good speed and type performance but some possible documentation and support problems.

CIRCLE #28 ON READER SERVICE CARD

This is not to say that the 190E's manual, which was right about the machine's emulations, is especially helpful. The sections are not clearly distinguished, and the monotonous type design does little to guide the reader. Also, the manual seems to be lacking explanations of some basic functions of the printer; for example, it does not explain the four-tone signal I received when I first turned the unit on. (The signal meant that I had forgotten to remove the plastic packing clip that holds the printhead in place.)

The 190E's Pica and Elite are available with a number of enhancements, including condensed, expanded, underlined, emphasized, and super- and subscript type, in both Epson and IBM modes. (Italic type is available, but only in Epson mode.) The machine also includes NLQ and proportional spacing.

The 14-pound printer has a 9-pin head, a Centronics parallel interface, and Line Feed, Form Feed, and NLQ membrane buttons. Its two DIP switches are located in different places—one on the front panel that controls more-frequently changed functions, and another underneath a removable rear panel.

In Pica, Laser Computer claims 160 characters per second for the 190E; as expected, it scored about 90 cps in our tests.

On the PC Labs Epson emulation test, the unit produced a significantly better image than in IBM Graphics mode. And on our noise test, the 190E hammered out 84 decibels, making it one of the louder printers tested.

The 190E seems to be solid in type clarity and consistency of performance, although the darkness of type varied in the form letter we use for our standard speed test. The printer handled a four-part form with no trouble, producing clearly legible copies all the way through. When printing on card-stock paper, however, the rear noise cover was pushed out of place when the paper was form-fed.

Laser Computer offers its own support line (not toll-free) during business hours, but don't expect to rely on Laser Computer's help if its lack of knowledge about the 190E's correct IBM emulation is any indication of the support staff's level of proficiency.

The Laser 190E is a dot matrix with average speed, acceptable type performance, and somewhat questionable documentation and support. At a \$209 street price, it is nothing more or less than an average OEM dot matrix.

## Laser 240

by David M. Stanton

The \$600 Laser 240 is the ritzier sibling of Laser Computer's Laser 190E, and it does most of what a printer's big brother should do. It handles larger paper, works more quickly, and produces crisper type than the 190E, but it does not offer all of the type options that its smaller counterpart does.

The 240 offers both IBM Proprinter and Epson FX-80 emulations. It also includes a slot for font cards, but Laser Computer says the cards will not be available until there is a demand for them. It's rather depressing to see a perfectly good font card slot—one that may have cost you some money—go unused.

Laser Computer initially told us that the 240 is merely a larger and faster version of the 190E, but in fact the two units offer quite different type options. In Proprinter mode, the 240 supplies only Pica enhanced by underlining and expanded options (as well as sub- and superscript). These options are far fewer than the 190E's IBM Graphics Printer mode offers. In Epson mode, however, the 240 is well

stocked; it features Pica, Elite, and NLQ, and its enhancements include condensed, expanded, proportional, underlining, and emphasized type.

In the PC Labs emulation test, the 240 produced a very dotty IBM Graphics im-

**The Laser 240's NLQ type is handsome, and the unit worked smoothly with four-part forms and card-stock paper.**

age and dark Proprinter and Epson images. In the latter modes, the printer also showed a tendency to lay on the ink too thickly, crinkling the paper. Our speed test showed the 240 operating at 147 characters per second in Epson mode—significantly faster than expected from a machine rated at 200 cps—but it could only muster 77 cps in IBM Proprinter mode. In NLQ mode the speed dropped to 37 cps.

The 9-pin 240 weighs in at 23 pounds and accommodates paper up to 16 inches wide. It has two 8-pin DIP switches, both located on the back of the printer, and a Centronics parallel interface. LED indicator lights and membrane buttons are locat-

## Laser 240

## Fonts &amp; Features

	Epson FX			
	Bold	Italic	Sub-Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				
	IBM Proprinter 9-pin			
	Bold	Italic	Sub-Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

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CIRCLE 538 ON READER SERVICE CARD





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### PRINTERS

### MONOCHROME DOT MATRIX

### LASER 240



### FACT FILE

Laser Computer Inc., 550 E. Main St., Lake Zurich, IL 60047-2576; (312) 540-8335.

List Price: \$500.

Dimensions (HWD): 5 x 24.5 x 14.5 in.

Weight: 23 lbs.

Emulations: Epson FX-80, IBM Proprinter

In Short: A somewhat quirky printer that still offers solid performance overall.

CIRCLE 625 ON READER SERVICE CARD

ed on the top right-hand side of the printer; among other things, the LED lights tell you which type pitch you are working in.

The 240's manual is generally easy to use but at times is confusing. The emulations, for example, are mentioned only once—in a short, easily overlooked introduction—and because the book is designed for use with two types of printers, you are sometimes unsure which statements apply to your unit. But the manual is well organized; ASCII commands are printed in large type, and the manual offers helpful remarks about their functions. The ASCII codes are also printed in the table of contents for easy reference.

The 240's NLQ type is handsome, and the unit worked smoothly with both four-part forms and card-stock paper. One drawback was the built-in tractor unit, whose sprockets hold the paper only as it exits the pressure roller. This construction is undesirable because there is much less pull available when you try to roll paper backwards.

The Laser 240 seems targeted for small businesses seeking professional-looking type, which it provides. At a street price of \$350 to \$380, it's a bit pricey, but its speed and type quality are good and its manual generally helpful. If the missing type options don't bother you, try this one.

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March 28, 1989

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## Mannesmann Tally 81

by Lori Grunin

The \$229 Mannesmann Tally 81 provides all the basic services one expects from a printer of its type at a reasonable price, but some inksome design details mar an otherwise good machine.

The Mannesmann Tally 81 faithfully emulates the Epson FX and the IBM Proprinter, producing good graphics images

### Mannesmann Tally 81 Fonts & Features

IBM Proprinter 9-pin				
	Bold	Italic	Sub-Super	Underline
10 cpi	■	■	■	■
12 cpi	■	■	■	■
Compressed	■	■	■	■
Proportional	■	■	■	■

Epson FX				
	Bold	Italic	Sub-Super	Underline
10 cpi	■	■	■	■
12 cpi	■	■	■	■
Compressed	■	■	■	■
Proportional	■	■	■	■

in both modes. It outputs readable Pica, Elite, 10-character-per-inch proportional, and NLQ characters at the relatively sedate clip of 73 characters per second in draft Pica (80 in the high-speed draft mode). The print quality can be partly attributed to the use of multistrike mylar ribbon cartridges rather than fabric.

You have a choice of pin or sheet feed, with paper parking controlled through key-presses on a three-button membrane panel. The company offers a \$199 100-page cut-sheet feeder (not included with our test unit).

This printer sets up painlessly—it's basically plug-and-play—although you have to supply your own cable. If you want to hook up through a serial port, you can buy a serial I/O interface card for the additional cost of \$45.

Unfortunately, Mannesmann Tally made some irritating design decisions. You can't adjust the printhead's distance from the platen. And the top cover is opaque, so it is necessary to remove it in order to see if you're at the top of a form or

to make sure the machine is printing correctly.

Most of the time you'll choose fonts through software, but if you decide to use the switches on the front panel, you're in for some confusion. Attributes are set by pressing the NLQ button a given number of times; for instance, if you want double-height characters, you need to press NLQ six times. Each time you press it, a tone sounds. But emphasized (bold) mode, which requires five presses, generates two tones. So in the middle of counting beeps, you suddenly get confused and lose count. Since the machine lacks an indicator to identify the current settings, you need to print a line of text to figure out what you've chosen.

In addition to the usual confusing illustrations and control-code tables, the Mannesmann Tally 81's manual assumes you can read music—or at least that you will know the difference between half and quarter notes and which of two notes on a staff is of a higher pitch.

### MANNESMANN TALLY 81



### FACT FILE



Mannesmann Tally Corp., 8301 S. 180th St., Kent, WA 98032; (206) 251-5580, (800) 426-4813.

List Price: \$229

Dimensions (HWD): 3.9 x 14.6 x 10.4 in

Weight: 11 lbs.

Emulations: IBM Proprinter, Epson FX-85

In Short: A 9-pin printer that can fill your light-to-medium draft printing needs. A good, but not great, printer at an affordable price.

CIRCLE 647 ON READER SERVICE CARD

## NEC Pinwriter P2200XE

by Wendy Murch

The \$499 NEC Pinwriter P2200XE replaces the NEC Pinwriter 2200—NEC's best-selling dot matrix printer ever. So it should come as no surprise that NEC made the new model compatible with all add-ons for the 2200. But that's not all—the 24-pin P2200XE features improved paper and en-

### NEC Pinwriter P2200XE Fonts & Features

Epson LQ-1500				
	Bold	Italic	Sub-Super	Underline
10 cpi	■	■	■	■
12 cpi	■	■	■	■
Compressed	■	■	■	■
Proportional	■	■	■	■

velope handling, more resident fonts (including Fast Focus, a high-speed letter-quality font), a lower price, more speed, and less noise.

I liked this printer from the first moment I saw it. It's lightweight (12.1 lbs.) and compact in size, yet it looks and feels durable. The four-button control panel across the front is impressively efficient. Each button has two labels; the upper set controls paper handling, print pitch, mode selection, and printer status functions, while the lower set controls the memory switches.

Take a quick glance at the Pinwriter's output and you may have to remind yourself that it rolled out of a dot matrix. The print is crisp and professional, with nary a smudge. The Pinwriter fared well on our speed tests, with a result of 104 characters per second—what we expect from its claimed 192 cps in high-speed draft mode—95 cps in draft, and 46 in NLQ. The other seven resident fonts are also of high quality, as are the many enhancements.

The Pinwriter receives a grade of B for paper handling. You have your choice of loading paper from either the front or the back, where both push- and pull-tractor loading methods are possible. Paper parking works well enough, even though it takes a little practice to get the paper properly squared up to the platen.

## NEC PINWRITER P2200XE



## FACT FILE

## EDITOR'S CHOICE

NEC Information Systems Inc., 1414 Massachusetts Ave., Boxborough, MA 01719, (617) 264-5000  
 List Price: \$499  
 Dimensions (HWD): 6.3 x 15.4 x 10.8 in.  
 Weight: 12.1 lbs.  
 Emulations: Epson LQ, Pinwriter Series  
**In Short:** This narrow-carriage 24-pin printer offers an excellent combination of price, ease of use, quality text output, and reasonable speed. It could, however, use a bit of improvement in the paper-handling department.

CIRCLE 649 ON READER SERVICE CARD

The envelope-loading process could use a little improvement if NEC wants to continue calling it "automatic." If you load an envelope according to the manual, it will not scroll up far enough to be printed on. When I took the cover off, I could easily push it in and line it up with one hand, but this process certainly defeats the whole purpose of auto-load.

On the PC Labs graphics test, the photo printed better than on most dot matrix printers we've seen. Graphics resolution tops out at a high 360 by 360 dots per inch. The gray-scale bars, however, didn't show enough distinctions between shades of gray.

The NEC Pinwriter P2200XE is a nice little piece of machinery. With its compact size, flexible paper paths, excellent print quality, thorough documentation, and reasonable price, it's a good, solid choice.

## Okidata Microline 172

by Ann Sherman

One of two new low-end dot matrix printers from Okidata, the \$289 Microline 172 promises good performance with few frills. While its nimble draft mode and smooth operation certainly make the 172 a

good bargain, be aware that such a "low, low" price brings with it a technology that is slightly outdated.

The printing options of the 172 are typical of low-end 9-pin printers. The menu, which the machine prints, includes HSD, Utility (draft), and NLQ print modes; pitches of 10, 12, and 17.1 characters per inch; and form lengths varying from 3 to 14 inches. Among the enhancements are italics, superscript, subscript, enhanced, emphasized (bold), and double-width text.

While your printing options are fairly complete, the selection process requires time and lots and lots of paper. With the paper loaded, depress the Select button on the front panel while turning on the power. The printer spits out the default setting—10-cpi Utility and 11-inch form length—and the setting of the first category that can be changed. To change the setting or to save the setting and move to another category, you must press either the Form Feed or the Line Feed button. The process is not terribly complicated, but you will be drowning in paper. Not only must you scroll through each setting until you find the one you want, but the printer moves seven lines after each option. Okidata is aware of this paper problem and is upgrading the printer so that it skips only two lines.

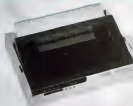
Okidata Microline 172  
Fonts & Features

		IBM Microline			
		Bold	Italic	Sub Script	Underline
10 cpi	Compressed				
	Proportional				
12 cpi	Compressed				
	Proportional				

The paper handling of the 172 is not glamorous but certainly dependable. Beyond the common rear U-fold path, you also get a bottom-feed. While the 172 has few paper-handling options, its standard external tractor and adjustable printhead maneuver paper without a sign of congestion. Even four-part forms and heavy card stock flowed through this featherweight machine without a jam.

The 172 also has advantages in speed. The Utility mode, a Gothic-type draft,

## OKIDATA MICROLINE 172



## FACT FILE

Okidata, 532 Fellowship Rd., Mount Laurel, NJ 08054, (800) OKI-DATA, (609) 235-2600.  
 List Price: \$289  
 Dimensions (HWD): 5.25 x 14 x 11 in.  
 Weight: 10.5 lbs.  
 Emulations: IBM Graphics Printer  
**In Short:** The Okidata Microline 172 offers a fast, readable draft, dependable paper handling, and small dimensions. The trade-off for inexpensive and reliable basics, however, is a limited emulation and a somewhat dated feature-selection process.

CIRCLE 648 ON READER SERVICE CARD

printed at 83 characters per second, while the high-speed draft clocked in at 91 cps. The NLQ—a well-formed Courier, if a little too light—came in at 34 cps.

The graphics are fast and as fine as single-density can provide in Okidata's claimed emulation, IBM Graphics Printer. However, in graphics mode, the 172 is compatible with the IBM Proprinter, an emulation that allows you to exploit the full 240 by 216 dots per inch of a quadruple-density image.

The printer has a few limitations. Like the Okidata Microline 182 Turbo (also reviewed here), the NLQ doesn't have bold or italics. Furthermore, the austere IBM Graphics emulation prevents you from accessing the printer's superset of enhancements. If your application doesn't have an IBM Microline driver, you'll have to customize one through the software package. Unlike the 182 Turbo, the 172 doesn't come in a standard version, so you cannot use the well-supported Microline driver.

From essential items like speed and good print to bonuses like a free optional serial interface, Okidata does what it can to accommodate users for under \$300. And if you need a printer primarily for drafts and occasionally for correspondence, the 172 is an excellent choice. However, if high-



PRINTERS  
MONOCHROME DOT MATRIX

quality type is important to you, choose one of the other comparably priced 9-pin machines that offer finer NLQ print.

## Okidata Microline 182 Turbo

by Ann Sherman

For \$339, the 9-pin Okidata Microline 182 Turbo offers an attractive combination of speed, print quality, and price in a compact package. Although the 182 is a little more modern in its technology than Okidata's other latest offering, the Microline 172 (also reviewed here), the 182 Turbo still has a little further to go before it's a star in its price range.

The 182 Turbo is one of the smallest nonportable dot matrix printers that we tested. The front control panel is a simple array of raised buttons for line feed, form feed, and printer select. There are two columns of LEDs that allow you to cycle through 10, 12, and 17.1 characters per inch and NLQ, Utility (draft), and high-speed-draft modes. You can select any combination of speed and pitch except

compressed NLQ. The DIP switches allow you to choose from four form lengths: 5.5, 8.5, 11, and 14 inches.

The 182 Turbo's bottom and rear U-fold feeds manipulate single sheets and

cluded with our test unit) may solve this.

In terms of performance, the 182 Turbo does quite well. The Utility mode churns out a readable Gothic type at 95 characters per second—the fastest draft under \$450. The HSD type is Utility with a smaller horizontal interval matrix. The characters are more skeletal, but they fly onto the page at a rate of 101 cps. The Courier-style letters of NLQ, at 37 cps, could be a little darker and have smoother edges, but they're more than acceptable for this price range. The 182 Turbo also offers italics, underlining, superscript, subscript, enhanced, emphasized (bold), and double-width text.

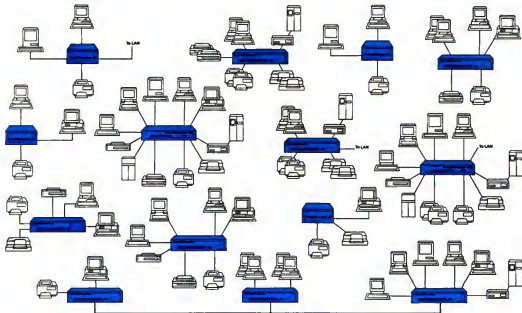
Your access to this fine text output is a bit limited in the 182 Turbo (IBM) model we tested. Its IBM Graphics Printer emulation lets you access only the draft typeface—without enhancements. If you don't have a Microline (IBM) driver in your application, you'll have to enter software codes to make full use of the printer. However, the latest releases of many applications do have a Microline (IBM) driver. Furthermore, at the same price, the Microline 182 Turbo comes in a Standard model (not tested here) that is compatible with the Microline driver family.

### Okidata Microline 182 Turbo Fonts & Features

	IBM Microline			
	Bold	Italic	Sub Superscript	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

continuous-form paper without a jam, and the mechanics are relatively self-explanatory. While four-part forms flowed smoothly around the platen or up through the bottom, heavy card stock turned the machine into a desktop trash compactor. A \$50 optional external tractor feed (not in-

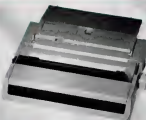
# More solutions for printer sharing



# PRINTERS

## MONOCHROME DOT MATRIX

### OKIDATA MICROLINE 182 TURBO



#### FACT FILE

Okidata, 532 Fellowship Rd., Mount Laurel, NJ 08054; (800) OKI-DATA, (609) 235-2600.  
List Price: \$339.

Dimensions (HWD): 4 x 15 x 14 7/8 in.  
Weight: 10 lbs.

**Emulations:** IBM 5150 Graphics Printer  
**In Short:** With the fastest draft under \$450, small dimensions, and an efficient front panel, the Okidata Microline 182 Turbo is a good low-end bargain. To take advantage of its fonts and features, buy the version with a Microline driver, which is supported by many applications.

CIRCLE 650 ON READER SERVICE CARD

The 182 Turbo has a few glitches. While the graphics images are good, the dreaded whine-of-the-dentist-drill spoils the fun a little. The IBM Graphics Printer emulation can access only single-density images; however, in graphics mode, the 182 Turbo is compatible with the IBM Proprinter, which can exploit the full 240 by 216 dots per inch.

The NLQ type, offering neither bold nor italics, is a little bit on the undermanned side. Furthermore, Okidata has not caught on to the paper-handling trends that are currently sweeping the low end of this market. The access cover lies about an inch above the printhead, and without forms tear off, it's the same old story—lose a sheet or lose an inch.

Despite some limitations, the IBM-compatible Okidata Microline 182 Turbo is a good, solid 9-pin printer. Its lack of a bold enhancement in NLQ may make the 182 Turbo impractical for final documents, but the printer's small size and fast Utility print make it an excellent choice for point-of-sale applications or as an extra draft printer for laser users.

## Output Technology 560DL

by Catherine D. Miller

Output Technology Corp.'s newest 9-pin dot matrix printer, the \$1,995 560DL, continues the high-volume printing tradition that OTC has fostered over the years. This hefty wide-carriage printer's dual printheads print simultaneously on a line, prompting OTC to claim a burst speed of 560 characters per second in 10-character-per-inch draft mode.

Slightly larger and significantly heavier than most wide-carriage printers, the 41-pound 560DL has a platen width of 16 inches. Continuous-form paper can be fed through the bottom or the front of the printer; the 560DL can't handle single-sheet paper. A printhead gap lever, designed to adjust the distance between platen and printheads, allows for a great deal of flexibility in paper thickness. The 560DL did a fine job with our three-part carbon-copy form and with the cardboard stock.

The 560DL has four emulations: the 9-pin IBM Proprinter, the Epson FX-100, the DEC LA210, and the DEC LA120.

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## Output Technology 560DL Fonts & Features

IBM Proprinter 9-pin				
	Bold	Italic	Sub-Super	Underline
10 cpi	■	■	■	■
12 cpi	■	■	■	■
Compressed	■	■	■	■
Proportional	■	■	■	■

Epson FX				
	Bold	Italic	Sub-Super	Underline
10 cpi	■	■	■	■
12 cpi	■	■	■	■
Compressed	■	■	■	■
Proportional	■	■	■	■

We tested its compatibility with the Proprinter and the Epson FX. The 560DL performed in these emulations flawlessly, and the graphics quality was good for a 9-pin printer.

While the 560DL supports bold, underline, compressed, expanded, superscript, and subscript, it doesn't support italic. It

has an NLQ mode but not a proportional. The 560DL is compatible with the high-order IBM character set, missing only character 127, the ASCII delete character.

OTC offers single-color ribbons are available from OTC—brown, blue, red, green—although the 560DL doesn't support four-color printing. Text printed in draft mode is satisfactory, and NLQ text was surprisingly good. Courier is the only resident typeface, but a free tool kit provides several downloadable fonts.

Since both printheads are active when you print in 80-column format, as well as when you use 136-column format, the 560DL should achieve greater speed than many printers when standard paper widths are used. Under the IBM Proprinter (9-pin) emulation, the 560DL managed 147 cps in draft using the narrow-carriage 80-column format and 267 cps using the wide-carriage 136-column format.

The control panel, located on the right side of the front of the case, includes buttons for Line Feed, Form Feed, Top of Form, and On/Off Line. Combinations of these buttons allow you to set NLQ and to move the paper up or down .0069 of an inch. A beeper warns you when the printer runs out of paper and when internal problems occur.

To access the menu-driven configuration procedure, the Form Feed button is held down during power-up. The Line Feed button serves as a yes key, and the Form Feed button serves as a no key. This procedure allows you to set the emulation, serial options, forms options, character set, and print style. You must also use this menu to set the pitch (adjustable in increments from 5.0 to 18.2), to enable the printing of subscripts and superscripts, and to set the buffer size so that the printer will accept downloaded fonts.

An excellent manual accompanies the 560DL. From configuring the printer to troubleshooting to entering control sequences, the documentation does a great job of describing the printer's capabilities and how to use them to full advantage.

This is a printer that appeals to a limited market and does its assigned job well. The Output Technology 560DL is a workhorse designed for fast high-volume draft printing in a 136-column format—typically needed in offices dominated by mainframes and minicomputers. It's also well-suited for continuous printing of multipart forms and cardboard stock.

## Panasonic KX-P1124

by Edward Mendelson

Since its introduction last year, Panasonic's \$530 KX-P1124 has set a new low-priced standard for 24-pin printers. This compact, narrow-carriage model produces excellent output at speeds high enough to serve almost all small-business and personal needs.

Its paper handling includes every modern convenience, such as paper parking, rear and bottom tractor feeds, and friction feed for single sheets. The front panel, with its membrane switches, controls every feature and option, so you never have to perform minor surgery on a block of inaccessible DIP switches in order to get something done.

PC Labs' speed tests clocked the KX-P1124 at 87 characters per second in draft mode. The Panasonic KX-P1124 produces

## Panasonic KX-P1124 Fonts & Features

Epson LQ-1500				
	Bold	Italic	Sub-Super	Underline
10 cpi	■	■	■	■
12 cpi	■	■	■	■
Compressed	■	■	■	■
Proportional	■	■	■	■

IBM Proprinter X24				
	Bold	Italic	Sub-Super	Underline
10 cpi	■	■	■	■
12 cpi	■	■	■	■
Compressed	■	■	■	■
Proportional	■	■	■	■

draft type that has jagged edges but is solid enough to be readable. The printer's "letter-quality" pitches come remarkably close to deserving that name. The sans serif font is smooth and easy to read, and the Courier and Prestige fonts aren't far behind. If the sturdy-looking bold proportional font isn't the best ever seen on a 24-pin printer, it's close. Script fonts probably should never be used at all, but Panasonic's script is one of the least offensive on the market.

You can load paper into the KX-P1124 in just about every way you can imagine. The tractor feed lets you load fanfold paper

## OUTPUT TECHNOLOGY 560DL



## FACT FILE

Output Technology Corp., 9922 E. Montgomery,  
#6, Spokane, WA 99206, (800) 422-4850, (509)  
926-3855

List Price: \$1,995

Dimensions (HWD): 6.3 x 27.4 x 16.7 in.

Weight: 41 lbs

Emulations: Epson FX-100, IBM Proprinter (9-pin), DEC LA210, DEC LA120

In Short: A fast dual-printhead printer designed for high-volume, wide-carriage printing in draft mode, the 9-pin 560DL is durable and well supported

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# PRINTERS MONOCHROME DOT MATRIX

## PANASONIC KX-P1124



### PC FACT FILE EDITOR'S CHOICE

Panasonic Industrial Co., Computer Products  
Division, 2 Panasonic Way, Secaucus, NJ 07094;  
(800) PIC-6066, (201) 348-7000  
List Price: \$530  
Dimensions (HWD): 5.6 x 16.9 x 14.1 in.  
Weight: 18.7 lbs  
Emulations: Epson FX, IBM Proprinter X24  
In Short: Panasonic's 24-pin KX-P1124 offers  
fast, high-quality printing in a small package.  
Excellent paper handling and no DIP switches  
add to the attractions of this relatively inexpensive  
model.

CIRCLE 167 ON READER SERVICE CARD

effortlessly from the rear, bottom, or even through a folding door in the front. A touch on a membrane switch and a press of a lever parks the fanfold paper so that you can feed individual sheets and envelopes through that folding door. A prominent line on the metal framework supporting the platen tells you exactly where printing will begin. The printer has more than enough adjustments for perfect printing of multipart forms and heavyweight paper.

Panasonic's control panel uses a combination of membrane switches and LED displays for far more than the standard selections of default font, pitch, lines per inch, and page length. You can also define up to three combinations of commands as macros and load the macros by pressing a couple of switches. You use the panel by an initially confusing but later highly intelligible system that lets you cycle through the rows and columns on the panel until you reach the combination you need. The settings are labeled clearly enough to let you dispense with the manual.

You'll need the manual, however, if you ever use the control panel to change the kinds of initial settings that most printers set with DIP switches. The KX-P1124 lets you use the panel to select one of 13 international character sets or to choose a

slashed zero or any of a dozen other settings, including a setting that turns off the error buzzer.

You can turn off the buzzer, but you can't turn off the 85 decibels of dentist-drill noise that the KX-P1124 inflicts on you in its default setting. The optional quiet mode helps make the sound of this printer a bit more tolerable, although at the price of reduced speed.

When it comes out of the box, this printer acts like an Epson LQ-2500, and its PC Labs text and graphics emulations were perfect. However, the optional IBM Proprinter X24 emulation produced narrow bands of denser printing at one-eighth-inch intervals, similar to those produced by some of the other printers reviewed in this survey.

Panasonic revised the BIOS of the KX-P1124 after the initial release of the printer in order to avoid a potential incompatibility with Epson drivers used by some applications. Starting with Revision D of the BIOS, the escape code that switches on the bold proportional font was changed to a code not used by Epson. As a result, software drivers that correctly produced the font with the old BIOS may produce the Courier font instead when used to run a printer that has the new BIOS. If you come across this problem, you'll need to get a revised driver from your software vendor—or you'll have to learn how to patch the driver on your own.

At \$530, the Panasonic KX-P1124 is a bargain among 24-pin printers. With its print quality, conveniences, and wide range of features, it would still be a bargain at a much higher price.

## Panasonic KX-P1180

by Edward Mendelson

This little gem of a printer is priced like zirconium but shines like a diamond—albeit a small one. At \$300 (and heavily discounted everywhere), Panasonic's 9-pin, narrow-carriage KX-P1180 is one of the few printers worth considering for low- or medium-duty use in a home office, college dorm, or small business.

The output of the KX-P1180 is good enough to stand next to the output from far more expensive 9-pin printers. The standard fixed-pitch fonts—Courier, Prestige, and sans serif—are a bit overly squarish but are still highly legible. Panasonic's

## Panasonic KX-P1180

### Fonts & Features

Epson FX				
	Bold	Italic	Sub Super	Underline
10 cpi	Orange	Orange	Orange	Orange
12 cpi	Orange	Orange	Orange	Orange
Compressed	Orange	Orange	Orange	Orange
Proportional	Orange	Orange	Orange	Orange

IBM Proprinter 9-pin				
	Bold	Italic	Sub Super	Underline
10 cpi	Orange	Gray	Orange	Orange
12 cpi	Orange	Gray	Orange	Orange
Compressed	Orange	Gray	Orange	Orange
Proportional	Orange	Gray	Orange	Orange

bold proportional font could be better shaped than it is, but 9-pin printers aren't really suitable for proportionally spaced printing anyway. If you want to preserve trees, you can print the fixed-pitch fonts with a 20-character-per-inch setting instead of the normal 17, 12, and 10 cpi.

At 59 characters per second in draft mode and 23 cps in NLQ in the PC Labs speed test, the KX-1180 won't burn rubber, but both speed and quality are impressively good for the price. The noise level of 73 decibels is in the reasonable-to-high range for this class of printer.

Measuring about 6 by 17 by 13.5 inches (HWD), the KX-P1180 is compact and lightweight but has a sturdy and reliable feel. You can load fanfold paper on the internal tractor from either the back or the bottom of the case, and you can park the fanfold paper temporarily while using a friction feed for single sheets and envelopes. The printer had no trouble handling multipart forms and heavyweight stock.

Loading fanfold paper from the bottom of the KX-P1180 is so effortless that you can do it with your eyes closed. Loading paper from the rear, however, is a test of faith and patience because you have to line up the holes in the paper with sprockets that you can't see at the bottom of the tractor wheels, and all you can do is hope that they'll eventually catch. The well-illustrated manual can't make this job any easier, but its detailed instructions reassure you that you aren't doing anything wrong as you struggle to make the paper line up correctly. If you buy this printer, make your

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The 8900 Series can print six- to nine-part forms at up to 400 characters per second, data processing applications at up to 600 cps or correspondence at 100 cps in the letter-quality mode. That kind of flexibility — not offered by many other printer manufacturers — makes the 8900 Series a natural for applications of all types.

What's more, these printers offer rugged reliability. Meantime between electronics failures is 9,000 hours with no duty cycle limitations. The 8900 Series can even replace some low-end line printers with its 16,000-pages-a-month output capability.\*

## **Intelligent printing means easy printing.**

What also sets 8900 Series printers apart is their combination of intelligent forms handling with flexible printing and paper handling capabilities. For example, TI's special Z-Axis Control™

printhead controller automatically senses a document's thickness and adjusts the printhead to its optimal position.

The Page Finder™ feature helps eliminate misaligned paper by automatically sensing the right and left margins, regardless of where the tractors are set or where the document is inserted. Plus, 8900 Series printers can automatically sense the top of forms to achieve zero tear-off. As a result, you don't have to worry about making adjustments yourself.

The 8900 Series also features a user-friendly control panel with a liquid crystal display. You can select options like print quality, font styles, menu status and others with the touch of a Powerkey™ button.

## **More features in one product.**

An 18-pin printhead ensures crisp, readable text, even on the last copy of up to nine-part forms. With five print speeds, the printers can handle high-speed reports as well as letter-quality correspondence.

Seven-color printing is also available. Some models offer a paper parking feature that enables you to feed a single form or other cut-sheet paper without having to disconnect the tractor feed.

## **The shared printer solution is a call away.**

Find out more about this unique cost-saving solution from TI. Call 1-800-527-3500.

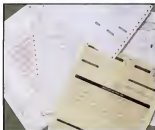
## **For single-user printing, try TI's new 83X Series.**

TI also provides you with a workstation printer solution. The Model 830 and 835 printers combine such personal printer features as an easy-to-use control panel and key forms printing features like short tear-off and a straight paper path.

The Model 830 is a narrow carriage printer while the 835 has a wide carriage. Both printers feature such versatile paper-handling characteristics as bottom, rear and top feed; automatic cut-sheet insertion; paper parking; and up to five-part forms printing.

You can also choose from options like a user-installable serial interface board; a sheet feeder; and a pull tractor (required for bottom-feed paperhandling).

Choose from three print speeds, including high-speed draft mode (300 cps), utility mode (250 cps) and near-letter-quality mode (63 cps). Whether you need the multi-user 8900 Series or the single-user 83X Series, TI offers you the printers you need when your needs are demanding.



TI's 8900 Series prints a variety of forms for a variety of users.



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**TEXAS  
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# PRINTERS MONOCHROME DOT MATRIX

## PANASONIC KX-P1180



### PC FACT FILE EDITOR'S CHOICE

Panasonic Industrial Co., Computer Products Division, 2 Panasonic Way, Secaucus, NJ 07094, (800) PIC-8086, (201) 348-7000  
List Price: \$299.95

Dimensions (HWD): 5.75 x 18.7 x 13.5 in.

Weight: 14.1 lbs

Emulations: Epson FX-86e, Epson FX-800, IBM Proprinter II

**In Short:** Panasonic's KX-P1180 is an inexpensive, well-constructed 9-pin printer with consistent print quality. This low-end model sports convenience features, like paper parking, normally found only in more expensive models. Fanfold paper loads easily from the bottom though more awkwardly from the rear, but few inexpensive printers can do any better.

CIRCLE 686 ON READER SERVICE CARD

minutes and use all its features with any software that supports the Epson or the Proprinter. The manual is clear and well organized in the sections that cover initial setup. The section that covers features used for programming the printer is less clear, but with the printer support that's built into today's software, only programmers will need to bother with these sections. If you're on a budget but want to pretend that you aren't, this printer is an excellent choice.

## Panasonic KX-P1191

by Edward Mendelson

Compared to Panasonic's low-end KX-P1180, the \$400 KX-P1191 both giveth and taketh away. The 9-pin KX-P1191 gives you extra speed, a buffer with 6K instead of 2K RAM, and a few relatively insignificant extra features. It takes away another hundred dollars from your wallet and, at a noise rating of 78 decibels, it takes away about 5 additional dB from the quiet of your office.

In draft mode, the KX-P1191's extra speed is too trivial to bother paying for: 65 characters per second compared to 59 for the cheaper model. But in NLQ mode, the KX-P1191 rates 35 cps, which is one and a half times faster than the KX-P1180. For many users, the difference will justify the extra price, while the 6K buffer (expandable to 38K) will cut down on traffic jams

## PANASONIC KX-P1191



### PC FACT FILE

Panasonic Industrial Co., Computer Products Division, 2 Panasonic Way, Secaucus, NJ 07094, (800) PIC-8086, (201) 348-7000

List Price: \$400

Dimensions (HWD): 5.2 x 16.7 x 13.5 in.

Weight: 15.7 lbs

Emulations: Epson FX-86e, Epson FX-800, IBM Proprinter II

**In Short:** Except for its faster speed and larger buffer, Panasonic's 9-pin KX-P1191 is almost identical to the low-end KX-P1180. Both have good, solid print quality and good-to-excellent paper handling. Loading fanfold paper from the rear can be awkward, but paper parking and an excellent bottom-loading mechanism compensate.

CIRCLE 689 ON READER SERVICE CARD

life easier by putting it on a stand that lets you load paper from the bottom.

Panasonic's front panel uses membrane switches that let you cycle through different settings for font, pitch, paper length, and a quiet mode. The quiet mode stays set once you choose it and can't be overridden by commands from an application. A micro-line-feed switch lets you align printing position precisely when filling in forms.

The KX-P1180 uses DIP switches to choose between its default Epson FX-86e/FX-800 emulation and an optional IBM Proprinter II emulation and to choose relatively arcane settings like international character sets and unidirectional versus bidirectional printing. Both emulations produced excellent results in both text and graphics.

The 2K buffer in the printer seems small by today's standards, but you can enlarge it to 34K with a \$60 expansion module. A cut-sheet feeder will set you back another \$149.95. You probably won't want the optional \$69.95 serial connection, but it's available if you do.

You can set up the KX-P1180 in a few

### Panasonic KX-P1191

## Fonts & Features

Epson FX				
	Bold	Italic	Size-Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				
IBM Proprinter 9-pin				
	Bold	Italic	Size-Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

as data moves from the computer to the printer.

Externally and internally, the KX-P1191 is almost identical to its slower sibling. Paper handling uses the same friction feed for individual sheets and internal tractor for fanfold paper. It takes work to line up the paper with the tractor for rear loading, but front loading is effortless, and you can easily park fanfold paper out of the way when loading individual sheets. Multipart forms and heavy paper stock won't make either of these printers stumble.

The membrane switches on the KX-P1191's front panel let you set the left and right margins and select italic or bold as the default font, in addition to the standard settings for font, pitch, paper length, and quiet mode. By combining switches on the front panel in ways you'll never remember without consulting the manual, you can adjust the printing position in increments as small as .0055 inch.

Panasonic's 9-pin fonts, which are identical in both the KX-P1180 and KX-P1191, are serviceable without being elegant. Flawless Epson FX-86e/FX-800 emulation is the default setting. IBM Proprinter



# PRINTERS MONOCHROME DOT MATRIX

## SEIKOSHA BP-5460



### PC FACT FILE

Seiksha America Inc., 1111 MacArthur Blvd.,  
Mahwah, NJ 07430; (800) 338-2609.  
List Price: \$1,999  
Dimensions (HWD): 7.625 x 23.25 x 15.75 in.  
Weight: 43 lbs.  
Emulations: Epson FX, IBM Graphics Printer  
In Short: This 8-pin, wide-carriage, high-speed  
dot matrix printer, which produced 239 cps during  
our test speed test, may be the answer to your  
firm's printing backlog.

CIRCLE 666 ON READER SERVICE CARD

II emulation, selectable via a DIP switch, is equally fine. Panasonic offers NLQ sans serif and bold proportional fonts in addition to the basic Prestige and Courier in draft and NLQ modes. When you use the Proprietary emulation, both printers give you access to the full IBM character set, except for ASCII 127, a character that more than a few printers refuse to print.

With its fine graphics capability, respectable speed, and advanced options like paper parking and micro-line feed, the KX-P1191 gives you almost anything you could want from a dot matrix printer for home or small-business use. A manual that's crystal clear for ordinary setup and mildly disorganized only in sections targeted for programmers adds to its attractions. If you can spare the extra cost and can live with the extra noise, the increased speed of NLQ printing in the KX-P1191 may make it a worthwhile step up from the otherwise equally excellent KX-P1180.

## Seiksha BP-5460

by Steve Lewiski

If you're frustrated by standing around and waiting for your own or your colleagues' documents and reports to print, the Seiksha BP-5460 may be the answer for you. Built to withstand long hours of continuous printing, the BP-5460 is certain to alleviate your print queue blues. This high-speed, wide-carriage, 8-pin (yes, 8-pin!) dot matrix printer goes for \$1,999.

The BP-5460 is Seiksha's second-fastest high-speed printer, surpassed only by the \$4,495 800-characters-per-second SBP-10AI (reviewed last year). In fact, the BP-5460 is actually a slightly improved version of the BP-5420AI (reviewed in our 1985 printer issue). The major enhancement is increased speed. Other changes are only cosmetic, such as the color of the printery outer shell and the shades of some

of the front-control-panel buttons.

But speed is not the only feature of the BP-5460. The printer contains two resident, DIP-switch-selectable emulations compatible with the Epson FX-80 and the IBM 5152 Graphics Printer. Output can be manipulated manually via the front control panel or through software selection to combine the Pica, Elite, condensed, and proportional pitches with print attributes such as bold, italic, underlined, double-strike, and double-width. The BP-5460 comes equipped with Centronics parallel and RS-232 serial interfaces, an 18K non-expandable print buffer, and a built-in temperature sensor to protect the printhead from overheating. An optional cut-sheet feeder is also available.

The Seiksha BP-5460 whipped out text at a rate of 238 cps in draft and 92 cps in quality mode. Considering the rate at which the draft characters are produced, they're more than adequate for in-house documents and reports. The letter-quality print was certainly better defined but still too rigid to be used for professional business correspondence. Unfortunately, the BP-5460's use of an 8-pin printhead is reflected in the quality of its graphs. Without a doubt, production in the Epson mode (which took 30 seconds) is superior to that

of the IBM mode (which took only 10 seconds), but both were streaky and had some difficulty forming solid vertical lines.

Manual operation of this printer is quite simple. The front-panel control is split into two segments, one for basic print operations—on-line, top-of-form, form and line feed, for example—and another with dials that control and display print-mode and form-length selections. The print-mode dial allows users to choose from any of the five draft or four quality print modes.

Another setting is also available: the "code set," which enables the use of software control. When the code set selection isn't invoked, software is not capable of overriding the manual selections. The form-length dial allows ten choices ranging anywhere between 8 and 22 inches, along with the 11-inch default, software-controllable code set. These dial selections are activated either on power-up or after pressing the adjacent reset button once a dial selection has been changed during the power-up state.

The paper-handling capabilities of the BP-5460 include friction-feed single cut sheets and a bidirectional pull tractor that handles fanfold paper either through the rear or bottom paper feed. Seiksha rates the BP-5460's paper-handling ability at 21 pound stock and five-part noncarbon forms; both passed PC Labs tests. An optional cut-sheet feeder with a capacity of 150 to 200 sheets is available for \$399. Snap-in replacement ribbon cartridges will run you \$16 each and should last for 5 million characters.

If speed is one of your primary requirements and you don't mind the quality of 8-pin dot matrix output, the Seiksha BP-5460 is a definite must-see. This durable, high-speed printer is ideal for situations where one or many users produce droves of spreadsheet or financial data, as well as lengthy internal documents.

## Seiksha SL-230AI

by Steve Lewiski

The \$1,149 SL-230AI is Seiksha's top-of-the-line 24-pin document printer. Targeted at the letter quality correspondence production departments of small and large businesses, Seiksha has attempted to package high-quality output with a complement of easy-to-use options and features. And for the most part, the company has succeeded.

Like other 24-pin printers, the wide-

### Seiksha BP-5460

## Fonts & Features

Epson FX					
		Bold	Italic	Sub Super	Underline
10 cpi					
12 cpi					
Compressed					
Proportional					

# PRINTERS MONOCHROME DOT MATRIX

## Seikosha SL-230AI Fonts & Features

### IBM Proprinter X24

	Bold	Italic	Sub-Super	Underline
10 cpi	■	■	■	■
12 cpi	■	■	■	■
Compressed	■	■	■	■
Proportional	■	■	■	■

### Epson LQ-1500

	Bold	Italic	Sub-Super	Underline
10 cpi	■	■	■	■
12 cpi	■	■	■	■
Compressed	■	■	■	■
Proportional	■	■	■	■

carriage SL-230AI is capable of printing a variety of character fonts, including draft, letter-quality, and proportional within the 10-, 12-, 15-, 17-, and 20-character-per-inch range. Additionally, 17 international character sets, a multitude of graphic print densities, and all the standard formatting enhancements are available, as well as centering and justification commands. Unlike most of its competitors, Seikosha has built in nine resident typefaces, including Courier, Gothic, Orator, Prestige Elite, Script, OCR-A, OCR-B, Roman, and Helvetica. In either of the SL-230AI's emulation modes—Epson LQ or IBM Proprinter XL24—users should find little difficulty producing attractive documents by incorporating the additional typefaces.

Font and typeface selections, as well as other features, can be accessed manually through the front control panel or via software control codes. The panel looks a little busy but supplies an abundance of control with its seven multipurpose buttons, three rotary dials, and a reset switch. Various paper-handling functions are also controlled through the console. A Cut selection allows continuous fanfold paper to advance to the perforation, be torn off, and then be returned to the top-of-form. The Visible button moves fanfold paper up to allow viewing while the button is pressed, then returns it to its original position once released. Optional paper-handling features include a \$250 single-bin cut-sheet feeder, a \$195 dual-bin cut-sheet attachment, and a \$100 bidirectional pull tractor.

On the PC Labs text speed test, the SL-

230AI produced well-formed draft characters at an unceremonious pace of 77 characters per second. The 49-cps letter-quality output appeared fine at first glance, but closer inspection revealed the fragile, coarse outline so common to dot matrix character resolution. Furthermore, the Roman typeface must be used in the proportional mode to avoid a spacing problem.

The graphics test also produced interesting results. In Epson emulation (which took 35 seconds), the halftones were less dense but more defined than those produced in IBM emulation (which took 43 seconds). Overall, the test results were a bit disappointing for a 24-pin dot matrix printer priced above \$1,000. Still, it should be noted that quality can be improved by using optional \$28 multistrike film ribbons.

A refreshing design element of the SL-230AI is the elimination of DIP switches. Instead, the printer uses a function card to control an assortment of standard settings. The function card approach may sound odd, but it's actually quite convenient in an environment where multiple users have different print requirements and can't be bothered by technicalities. To install the card, simply power down the printer and

insert the card in the slot located on the front of the printer.

Other notable features include automatic loading for both cut-sheet and fanfold paper, thermal control (which automatically shuts down the printhead), separate paper-bail and paper-release levers, and an optional \$50 64K memory upgrade, which seems extremely appealing during large print jobs.

The Seikosha SL-230AI's ability to produce an assortment of acceptable letter-quality documents and its multitude of features and options makes it fine choice for small businesses with limited budgets. But until Seikosha further enhances the SL-230AI's output quality and print rate, expect larger corporations to stick with faster dot matrix printers for in-house applications and laser printers for their professional correspondence.

## Seikosha SP-1600AI

by Steve Lewis

Seikosha's low-end entry for this year's printer review, the \$329 SP-1600AI, is not only well priced and easy to use for a narrow-carriage 9-pin dot matrix printer but is also loaded with many practical features for a printer in this class.

Although the Centronics parallel SP-1600AI version lists for \$329, an RS-232 serial model—the SP-1600AS—sells for \$349. Through DIP-switch selection, the SP-1600AI is capable of emulating either the Epson FX-80 or the IBM 5152 Graphics Printer. In PC Labs' text-speed tests, the SP-1600AI produced acceptable draft and adequate NLQ print in both emulations at a rate of 79 and 27 characters per second, respectively. On graphics speed tests, the FX-80 emulation produced denser and more-precise output, especially on curves, than the IBM mode. But the Epson emulation took nearly twice as long to output—65 seconds versus 37 seconds for the IBM mode.

In addition to the two emulation modes, the SP-1600AI also offers automatic paper loading and ejection, proportional and graphics print modes, 11 international character sets (including IBM's high-order set), and the standard print enhancements, such as double-width, bold, italic, double-strike, and super- and subscript.

During operation, the SP-1600AI allows the user to determine character pitch and margin settings in a rather unique, easy-to-use fashion. By combining front-

### SEIKOSHA SL230AI



### PC MAGAZINE FACT FILE

Seikosha America Inc., 1111 MacArthur Blvd., Mahwah, NJ 07430; (800) 338-2609

List Price: \$1,149

Dimensions (HWD): 4 8/5 x 24 x 13.75 in.

Weight: 26 lbs.

Emulations: Epson LQ, IBM Proprinter XL24

In Short: This sharp-looking, 24-pin, wide-carriage dot matrix printer combines a bundle of easy-to-use features and options with acceptable-quality output. Although it's probably not right for many large corporations, it ought to find a home in small businesses.

CIRCLE 861 ON READER SERVICE CARD

# PRINTERS MONOCHROME DOT MATRIX

## Seikosha SP-1600AI Fonts & Features

### Epson FX

	Bold	Italic	Sub Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

panel operations with printhead positioning, selections are set and can't be overwritten by software commands. The SP-1600AI's pitch-control settings include Pica (10), Elite (12), condensed (17 and 20 pitch), proportional, and code—the default setting that allows software commands to control printer operations.

In addition to assisting with pitch and margin settings, the front panel has four buttons that control form and line feeds as well as the on-line and NLQ status. The last two have LEDs that are illuminated if that function is active. There are also power and paper-out LED indicators.

The paper-handling features of the SP-1600AI rival those of printers in the more-expensive classes. As if loading fanfold paper weren't easy enough, loading cut-

sheet paper is even simpler. Just remove the detachable tractor, place the paper guide on its supports, throw in some paper, and the paper is automatically positioned at the top of a form. For an additional \$149, you can purchase an automatic cut-sheet feeder, increasing your cut-sheet capacity to anywhere from 150 to 200 pages. We exceeded the printer's stated maximums of 21-pound paper and three-part multipart forms by successfully testing 40-pound card stock and four-part forms.

Seikosha has packaged quite a few nice features into this relatively inexpensive, simple-to-operate 9-pin dot matrix printer. Although its NLQ print would not be acceptable for large corporations, the Seikosha SP-1600AI is ideal for small-business and home use.

## Siemens Ink Jet PT 90-12

by Luisa Simone

The Siemens Ink Jet PT 90-12 is a \$1,500 ink jet printer that will make some people smile and a lot of other people climb the walls. It's fast, quiet, and sturdy, but most other aspects of this model are just plain annoying.

The PT 90-12 is a printer that requires patience and fortitude during installation. There are little frustrations: for example, there is no physical switch on the front control panel to either invoke letter-quality mode or change the type pitch. And then there are big frustrations—although Siemens claims that the PT 90-12 is compatible with the 24-pin IBM Proprinter, using that emulation for the PC Labs benchmark tests resulted in control characters being printed.

The PT 90-12 did function with the 9-pin Proprinter driver. But there isn't much point in paying \$1,500 for a 32-nozzle ink jet printer if you are restricted to a 9-pin dot matrix emulation. Even then, I can't guarantee that the PT 90-12 is 100-percent compatible with the 9-pin Proprinter. The escape sequences for Italic printing, for example, did not work in our test sample. And I found that the type occasionally suffered from misaligned dots, causing blurred letters.

These problems disappeared when we used proprietary Siemens drivers. The text on several sample files provided with the

printer was extremely clean on even the tiniest type size. Siemens will supply proprietary drivers for several popular software programs, including *Microsoft Word*, *Microsoft Chart*, *WordPerfect*, *Microsoft Windows/286* or *1386*, and *GEM/3 Desktop*.

When we converted the PC Labs graphics file to take advantage of the Siemens *Windows* driver, the difference was startling. Instead of the large, simple dot pattern of the Proprinter, true halftones (at a resolution of 240 dots per inch) rose up out of the PT 90-12 like Venus rising from the waves.

The Proprinter version of the PT 90-12 that we received for review is only one of four versions manufactured by Siemens. You might have better luck if you opt for the *Diablo* emulation instead. The other two emulations, Siemens/ECMA and Siemens PC-D, which are European standards, reveal the PT 90-12's foreign origins and may perhaps explain the language barrier that exists between the PT 90-12 and the Proprinter driver. In fact, if you experience trouble, the printer's manual suggests that you either modify an existing driver or write your own driver in order to make full use of the printer's potential.

If you can get this printer going, you'll discover that it is swift. The PC Labs test

### SEIKOSHA SP-1600AI



### PC FACT FILE



Seikosha America Inc., 1111 Macarthur Blvd., Mahwah, NJ 07430; (800) 338-2609.  
List Price: \$329  
Dimensions (HWD): 4.625 x 11 x 15.75 in.  
Weight: 9 lbs.  
Emulations: Epson FX, IBM Graphics Printer  
In Short: This easy-to-use, narrow-carriage, 9-pin dot matrix is loaded with useful features. With its low price, the SP-1600AI becomes ideal for small-business and home use

CIRCLE 666 ON READER SERVICE CARD

### Siemens Ink Jet PT 90-12

## Fonts & Features

### IBM Proprinter 9-pin

	Bold	Italic	Sub Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

letter printed out at 136 characters per second in draft mode and nearly that fast in proportional mode.

But fast certainly doesn't mean versatile. The PT-90 has its share of type and format enhancements, but the typeface selection—even if you opt for one of the five \$138 font expansion modules—is too limited for my taste. Furthermore, even those standard enhancements that the PT 90-12 can handle—expanded type, boldface, or 15 characters per inch—can be accessed only through software codes or from a lengthy menu; there are no front-panel

# It's everything the leading laser printer would

The image shows two Toshiba LaserJet printers. The larger printer in the background is a desktop model with a paper tray on top and a control panel with buttons labeled 'COPY', 'PRINT', 'PAUSE', and 'STOP'. It is printing a document titled 'SALES BY REGION' with a bar chart. The smaller printer in the foreground is a more compact model, also printing a document titled 'SALES ANALYSIS' with a bar chart. A laptop is visible on the left side of the foreground printer.

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SALES ANALYSIS  
TOTAL SALES BY REGION

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SALES ANALYSIS  
TOTAL SALES BY REGION

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Toshiba America Information Systems Inc., Computer Systems Division

**PRINTERS**  
**MONOCHROME DOT MATRIX**

shortcuts for this printer.

Every ounce of the PT 90-12's 44 pounds is put to use in making this one of the sturdiest and quietest printers I've seen. Both the internal tractor feed and the optional cut-sheet feeder are thoughtfully designed and solidly built. For example, the cut-sheet feeder has a paper tray that catches your printouts in either inverted or normal order. And it was no surprise to learn that Siemens sells a lot of these printers to sites where noise is verboten—like hospitals.

If you work in a quiet zone or are dealing with a large-volume purchase, the inevitable installation problems that you will run into with this printer may be offset by long-term benefits. The Siemens Ink Jet PT 90-12 is designed for endurance; it will print graphics and a minimum number of typefaces speedily and in hushed tones. But individual users who are not willing to write or modify drivers for the unit will find it difficult to access this printer's inherent potential. If you must buy the Siemens PT 90-12, insist that the company supply you with proprietary drivers for your major applications.



**SIEMENS INK JET PT 90-12**



**FACT FILE**

Siemens Information Systems, 20 Olney Ave., P.O. Box 5040, Cherry Hill, NJ 08034; (609) 751-6958.

List Price: \$1,500.

Dimensions (HWD): 7 x 25.5 x 16.25 in.

Weight: 44 lbs.

Emulations: IBM Proprietary

**In Short:** If this printer were considered on the basis of hardware alone, the 32-nozzle ink jet printhead, quiet operation, and sturdy paper-feed mechanisms would win it high marks. However, a poorly implemented Proprietary emulation makes it difficult to use this printer without delving into driver modifications.

CIRCLE 688 ON READER SERVICE CARD

## Siemens PT 88S-32

by Luisa Simone

Siemens Information Systems claims that the \$718 PT 88S-32 sports a silent nine-nozzle ink jet printhead, no-fuss paper-handling mechanisms, and the IBM Proprietary emulation. But up at bat, this printer strikes out in two of those three categories.

The good news is that this printer is very quiet. Indeed, a document can print out without your even noticing. And the internal tractor feed was hassle-free.

Paper-handling functions are practically nonexistent. Sheet-cut paper must be fed manually. Paper parking does not exist. The top of a form is determined by the position at which the paper is located when the printer is turned on. And because there is no roller bar on the platen, you must keep the paper aligned with the tear-off edge on the cover, effectively making the first 1.33 inches of paper unprintable.

More importantly, I found that the PT 88S-32 worked inconsistently with the Proprietary driver. The most frustrating problem was that the printer refused to accept the escape-code that should toggle between draft and NLQ printing modes. Delving into the manual revealed an escape-code sequence that did not match the NLQ/draft codes for a true Proprietary emulation. That, however, is a moot point, because it didn't matter whether I used true Proprietary escape sequences or the incorrect code listed in the manual: the only way to switch over to NLQ or back to draft was either to flip a DIP switch or to use the front control panel (take the printer off line, hold down both the Line Feed and Form Feed buttons). Siemens promises that, by the time this issue is published, the incompatibility problems with the Proprietary driver and the incorrect codes in the manual will have already been fixed.

At 97 and 33 characters per second for draft and NLQ, respectively, the PT 88S-32 is fast enough for most applications. However, it has no capability to print either italic or proportional type—two basic requirements for business correspondence.

The PT 88S had no problems with the PC Labs graphic test image. It faithfully mimicked both the Proprietary and the IBM Graphics Printer. However, a .25-inch hard left margin, which cannot be changed except by manually repositioning the pa-

Siemens PT 88S-32

## Fonts & Features

	IBM Proprietary 9-pin	IBM Graphics Printer	IBM Graphics Printer	IBM Graphics Printer
10 cpi	Yes	Yes	Yes	Yes
12 cpi	Yes	Yes	Yes	Yes
Compressed	Yes	Yes	Yes	Yes
Proportional	Yes	Yes	Yes	Yes

per, makes it nearly impossible to print the full width of the sheet. The manual explains this as a preventive measure—printing over the perforation can introduce paper dust into the nozzles.

Siemens admits that OEMs form a large part of their customer base, and various facts support that statement. The company's price list includes discounts for large quantities. The manual also contains instructions on how to dismantle the printer in order to insert boards for the various emulation and interface options. The model we received for review was the PT 88S-32: the IBM Proprietary emulation. Also available are the PT 88S-31 (which employs the

**SIEMENS PT 88S-32**



**FACT FILE**

Siemens Information Systems, 20 Olney Ave., P.O. Box 5040, Cherry Hill, NJ 08034; (609) 751-6958.

List Price: \$718.

Dimensions (HWD): 5.5 x 16.25 x 12 in.

Weight: 17 lbs.

Emulations: IBM Graphics Printer, IBM Proprietary

**In Short:** With only draft and NLQ typefaces to choose from and unsophisticated paper-handling features, the Siemens PT 88S-32 is too limited a printer for most business correspondence.

CIRCLE 684 ON READER SERVICE CARD

# PRINTERS MONOCHROME DOT MATRIX

## STAR MICRONICS XR-1500 MULTI FONT



Star Micronics America Inc., 420 Lexington Ave., #2710, New York, NY 10170; (212) 966-6770.  
List Price: \$799.  
Dimensions (HWD): 5.5 x 23.5 x 13.5 in.  
Weight: 23.1 lbs.  
Emulations: Epson FX, IBM Proprinter (9-pin)  
In Short: The Star Micronics XR-1500 Multi Font is a workhorse 9-pin wide-carriage printer with good speed, eight built-in fonts, and easy-to-use control panel and paper delivery systems. This attractive printer has lots to recommend it as a home-office or small-business printer.

CIRCLE 653 ON READER SERVICE CARD

Siemens ECMA standard for the European market), and the PT 88S-34 (Epson FX emulation). Certainly OEMs have both the incentive and the expertise to solve the compatibility problems I experienced during testing. In addition, they have the volume-purchasing power to bypass the normally high price of \$746 (the printer plus the parallel interface).

Purchased from an OEM as part of a turnkey system and used only for internal or basic correspondence, the Siemens PT 88S might shine as an extremely quiet, very sturdy printer. However, most business users looking for a printer with a full complement of type enhancements and easy-to-use emulations will find the PT 88S-32 too limited.

## Star Micronics XR-1500 Multi Font

by Bruce Brown

Star Micronics' \$799 9-pin wide-carriage XR-1500 Multi Font is a good all-around machine for printing everything from mailing labels to spreadsheets and from correspondence-quality type to low-level graphics.

The XR-1500 is the company's workhorse machine. It includes Epson FX and IBM Proprinter (9-pin) emulations standard and Epson JX-80 color command set emulation with the \$50 color option (not sent in time for testing in this roundup). Moderately fast, the XR-1500 scored 127

characters per second in 10-character-per-inch draft mode, 49 cps in NLQ mode, and 51 cps in NLQ proportional mode. The print quality is about as good as it gets with 9-pin printers, offering clear type and graphics that are certainly good enough for internal company use and for personal projects.

One of the distinct advantages of the XR-1500 is its complement of resident fonts. Star Micronics must have caught a big font wave, because there are eight resident NLQ fonts in addition to draft on this machine. The typefaces are draft, sans serif, Orator, OCR-B, Cinema, Courier, Letter Gothic, Script, and TW-Light. If you can't find what you want in that bunch, you're looking at the wrong class of printer and should be prepared to spend lots more money or cope with the interesting world of downloaded fonts.

If you want to ride the wave even further, optional font cartridges will be available for the XR-1500 by the time this review appears. Pricing and font specifics for the optional cartridges weren't available at press time.

A Centronics parallel interface is standard. If you're one of the rare users who want a serial port, Star Micronics will sell

you one, complete with 8K printer buffer, for \$100.

The printer control panel uses lots of small raised buttons and LED indicators to choose fonts and print settings without resorting to software. The panel is well laid out and easy to use. Standard black fabric ribbons cost \$10 and have a rated life of 6 million characters.

Paper is fed into the XR-1500 from the rear only, with both friction and push-type tractor feed standard. An optional single-bin cut-sheet feeder costs \$250, and an external pull-type tractor will be available, but the price was not fixed at press time. Paper parking using the internal tractor worked well, with just one button to load or park continuous-form paper.

The XR-1500 comes with a sizable 32K buffer, expandable to a maximum of 64K with a 32K memory option board, though—you guessed it—the price for the memory upgrade wasn't available.

There are no minuses with the XR-1500. At \$799, it's a reasonably priced wide-carriage 9-pin printer with an exceptional number of resident fonts. If you want to save some money and don't need wide-carriage printing, a narrow version, the XR-1000, which we did not see, lists for just \$579.

## Star Micronics XB-2410 Multi Font

by Bruce Brown

Star Micronics' \$749 24-pin narrow-carriage XB-2410 may be the next best thing to a laser printer for folks who can't afford a laser but want great print quality and a good selection of fonts.

The XB-2410 offers excellent NLQ print in a total of 14—count 'em, 14—resident fonts. If that's not enough, there's also a Super Letter Quality mode that works with two of the fonts, TMS ROMN and TW-Light. No, the print from this machine isn't as good as that of a laser or other page printer, but it's right up there with the best 24-pin dot matrix printers, which is darned good. The highest graphics resolution is 360 dots per inch in both horizontal and vertical orientations.

The XB-2410's resident fonts include Draft, TW ROMN, TW-Light, Courier, Prestige, Script, OCR-B, OCR-A, Letter Gothic, Blippo, Orator, Helvet, Optimo, Cinema, Code 39, and Greek. For most standard business users, this many fonts is

### Star Micronics XR-1500 Multi Font Fonts & Features

#### IBM Proprinter 9-pin

	Bold	Italic	Sub-Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

#### Epson FX

	Bold	Italic	Sub-Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				



overkill, but the combination of fonts and print quality is great to have if you need it.

You can access the fonts via the well-laid-out control panel with small buttons and LEDs or via printer-control codes from any of the XB-2410's three emulations: Epson LQ, IBM Proprinter, and NEC Pinwriter. Font, pitch, and print-quality are set from the control panel. The XB-2410 also has ingenious hardware "locks," a feature that lets you lock-in font, pitch, and print quality so that they can't be changed by software. While most of us let our software control printer action most or all of the time, there are programs that want to control the printer entirely but that don't give access to all printer features. With the Star Micronics' locking feature, you can override inhospitable software—a nice touch.

The XB-2410 is slower than many 9-pin printers in draft mode, scoring 117 characters per second in 10 cpi on our speed test, but it buzzed right along at 54 cps in LQ mode and 75 cps in LQ proportional mode. The extra effort the printer makes to produce Super Letter Quality slows speed down to a tested 29 cps.

A Centronics parallel interface is standard; a serial interface with an 8K buffer is a \$100 option. You can either feed single sheets with pressure feed or use the internal push tractor for continuous-form paper. An optional external pull tractor (price not set at press time) and a \$160 single-bin cut-sheet feeder are also available.

Other planned options with undetermined prices include optional font cards

## PRINTERS MONOCHROME DOT MATRIX

### STAR MICRONICS XB-2410 MULTI FONT



### PC FACT FILE

Star Micronics America Inc., 420 Lexington Ave., #2710, New York, NY 10170; (212) 966-6170.  
List Price: \$749  
Dimensions (HWD): 5.5 x 17.75 x 13.5 in.  
Weight: 17.6 lbs.  
Emulations: IBM Proprinter, Epson LQ, NEC Pinwriter  
In Short: The Star Micronics XB-2410 Multi Font produces beautiful character print and graphics with its 24-pin head. At \$749, the XB-2410 has an astounding 14 resident fonts and includes a Super Letter Quality mode. If you're looking for a top-quality dot matrix printer, you can stop right here.

CIRCLE 652 ON READER SERVICE CARD

### Star Micronics XB-2410 Multi Font Fonts & Features

#### IBM Proprinter 8-pin

	Bold	Italic	Self-Register	Underline
10 cpi	■	■	■	■
12 cpi	■	■	■	■
Compressed	■	■	■	■
Proportional	■	■	■	■

#### Epson LQ-1500

	Bold	Italic	Self-Register	Underline
10 cpi	■	■	■	■
12 cpi	■	■	■	■
Compressed	■	■	■	■
Proportional	■	■	■	■

and a 32K memory upgrade to take the standard 32K buffer up to the 64K maximum. The font cards are planned even though the XB-2410's standard fonts should certainly be enough for all but the most unusual needs.

Black fabric ribbons with a life expectancy of 3 million characters cost \$9.50 each, and a four-color ribbon for use with the Epson LQ-2500 emulation costs \$20.00. The optional color kit (not sent to us in time for testing) costs \$50. The printer's ribbons are clam-style cartridges that can be quickly installed without getting ink all over your fingers.

The Star Micronics XB-2410 Multi Font is a classy 24-pin printer with loads of fonts and reasonable speed for its class. It isn't a laser printer, but it offers great print and does continuous-form mailing labels and multipart forms. A lot more expensive than other narrow-carriage 24-pin printers—such as the \$499 NEC Pinwriter P2200XE and the \$530 Panasonic KX-P1124—it's also a bit faster.

## Tandy DMP 107

by M. David Stone

If the Tandy DMP 107 were an airplane ticket, it would be for a discount seat on a cut-rate airline—with no food, no drinks, and quite possibly no magazines. But then, at the no-frills price of \$280, what more could you ask for than just doing the job of printing?

In most ways, the DMP 107 is best described as a minimalist version of the venerable IBM Graphics Printer with a Tandy mode and character set tacked on for good measure. As such, it's pretty much what you would expect: a low-end, narrow-carriage, 9-pin dot matrix printer with nearly universal software support. However, that's not all this printer is about; it was built with two aims in mind. It's designed to work with older Tandy hardware, such as the TRS-80 Model II and the Color Computer. But it's also meant to accommodate the company's movement toward IBM compatibility. The result is a mixed bag of tricks.

The need to serve both past and present explains the more-individualistic—some might say more-eccentric—aspects of this printer. For example, it certainly explains the serial connector that's meant for the Color Computer. And it also helps explain the reason why the parallel connector isn't wired for a standard IBM parallel cable. Instead, you need a special cable, which is available from Tandy. And be aware that Tandy will not reconfigure the DMP 107 for a standard cable. Although the company will reconfigure some other Tandy printers reviewed here.

Nowhere does the minimalist design of this printer show quite so well as in the front-panel controls. There's a single status light that indicates power-on and a single button that sets the printer on- or off-line. The only other feature controls (located elsewhere on the printer) are the on/off

### Tandy DMP 107 Fonts & Features

#### Tandy

	Bold	Italic	Self-Register	Underline
10 cpi	■	■	■	■
12 cpi	■	■	■	■
Compressed	■	■	■	■
Proportional	■	■	■	■

PRINTERS  
MONOCHROME DOT MATRIX

switch and four DIP switches.

In the PC Labs benchmark tests, the DMP 107 generally performed appropriately for a printer that costs \$280. On the text speed test, the claimed rate of 100 characters per second translated to a measured 48 characters per second for draft mode and about 16 cps for NLQ mode. On the graphics speed test, the DMP 107 clocked in at 53 seconds.

The print quality has both good and bad points. NLQ text—particularly proportionally spaced NLQ text—is highly readable with acceptably dark, solid characters. Unfortunately, draft-quality text is somewhat gray and is not the sort of output you will want to read much of in one sitting.

The graphics quality is also mixed. The output retains intricate detail; it printed the IBM Graphics Printer emulation without problems. However, the printing is gray, and solid areas are not truly solid. Put these together, and the overall output is less than ideal—but better than you might expect at this price.

Setup is trivial, essentially limited to loading ribbon and paper and plugging the printer in. The built-in push tractor is easy to load and adjust. Surprisingly, the DMP 107 handled the multipart forms on PC Labs' tests without problems, even though Tandy claims only a maximum two-part

form thickness for the printer.

The tractor feed also handled heavy-weight paper reasonably well, but not well enough for someone to trust the printer on its own. The bail is not strong enough to hold the heavy paper down, so the paper is in constant danger of folding itself under the bail and jamming. The bail never quite gave out during PC Labs testing, but I'd

stay and watch when printing, just to be sure.

The Tandy DMP 107 is a credible low-end printer. While it is hard to justify any printer this slow for business use, the DMP 107 may be appropriate if, for example, you're looking for an inexpensive printer to keep at home for occasional use with your laptop system. If that's your need and \$280 is your budget, the DMP 107 may be the right choice.

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### TANDY DMP 107



### PC FACT FILE

Tandy Corp., 1800 One Tandy Dr., Fort Worth, TX 76102, (817) 390-3700

List Price: \$280

Dimensions (HWD): 4 x 14.5 x 10 in.

Weight: 6.6 lbs

Emulations: IBM Graphics Printer, Tandy

In Short: This inexpensive, 9-pin, narrow-carriage printer is a tad cheaper than others, but it's also slower, and its print quality isn't as good

CIRCLE 643 ON READER SERVICE CARD

**PRINTERS**  
**MONOCHROME DOT MATRIX**

## Tandy DMP 133

by M. David Stone

The Tandy DMP 133 is the big brother of the DMP 107. It's slightly larger than the 107, slightly heavier, and possibly more sturdy, as well. It's also slightly faster. But like the 107, the DMP 133 is clearly a low-end printer, offering 9-pin printing, IBM Graphics Printer compatibility, and a reasonably low price of \$380.

There are other features that the two printers share, as well. In particular, the DMP 133 includes a Tandy mode and Tandy character set in addition to the IBM Graphics Printer mode and IBM character set. It also includes a serial connector specific to the Color Computer, as well as a parallel connector that isn't wired for a standard parallel cable and can't be modified for one. As an MS-DOS user, you'll need the special cable sold by Tandy.

Aside from its Tandy-specific idiosyncrasies, the DMP 133 offers little to distinguish it from the pack. On the PC Labs speed tests, draft mode came in at a respectable 67 characters per second, but the quality is of the sort that used to give computer printouts a bad name. The type is far too light, and the characters are formed with absurdly distinct dots.

### TANDY DMP 133



**PC** **FACT FILE**

Tandy Corp., 1800 One Tandy Dr., Fort Worth, TX 76102, (817) 390-3700.

List Price: \$380.

Dimensions (HWD): 6 x 16.5 x 11 in.

Weight: 7.3 lbs.

Emulations: IBM Graphics Printer, Tandy

In Short: Although slightly slower than its sibling, the DMP 107, the 9-pin, narrow-carriage Tandy DMP 133 offers little else to justify its \$100 higher price.

CIRCLE 664 ON READER SERVICE CARD

from the roller, and removes the printer's top cover. The smaller, lighter DMP 107 actually fared better in feeding heavy-weight paper.

Ultimately, the real problem for this printer is cost. Listing for \$380 and available only at Radio Shack stores at full list price, the DMP 133 is less than \$200 below the street price of an HP DeskJet. And it's higher than the street price of, for example, an Epson LQ-500.

At this price, the Tandy DMP 133 may be of interest if you want a printer for your old Color Computer that can also double as a backup printer for your MS-DOS system. However, I'd be inclined to go with the DMP 107 for \$100 less. Although it's slightly slower, its print quality is just as good and its paper handling better. At \$380, it's hard to see a reason to buy the DMP 133.

## Tandy DMP 300

by M. David Stone

Buyers on strict budgets look for basic features and solid values in the 24-pin dot matrix market; the \$649 Tandy DMP 300 offers just those attributes. Here you'll find a combination of speed, print quality, and price that will grab your attention. You'll also find IBM Proprinter X24 emulation, which should work with most of your software.

Alas, you will also find some minor quirks. Like other printers from Tandy, the DMP 300 is shipped needing a \$55 specially wired cable. The cable is available

### Tandy DMP 133

#### Fonts & Features

	Tandy			
	Solid	Italic	Sub-Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

The so-called letter quality—actually a correspondence quality—clocks in at 24 cps. The text is reasonably solid: both darker and far more readable than draft mode, it is still nothing to rave about. In fact, both draft and letter-quality text are almost identical to the output from the DMP 107. Alas, what is forgivable in a \$280 printer is somewhat less so in a printer that costs \$100 more.

On the graphics tests, the DMP 133 managed a relatively fast 42 seconds. The output has a washed-out look, with uneven coverage in solid areas, but the patterns and cross-hatched areas retain detail. The

scanned photo keeps enough shading to look more or less like a photograph if you hold it at arm's length. Here again, the output is almost identical to output from the less expensive DMP 107. The printer handled the compatibility test for the IBM Graphics Printer without problems.

Paper handling is not one of this printer's strengths. While running the PC Labs benchmark tests—fewer than 50 pages of fanfold paper—the printer jammed four times, with the paper coming off the built-in push tractor. In fairness, the problem came from a slight misadjustment in the tractor positions and disappeared when I finally got the positioning right. But the tractor feed is undeniably finicky—far more so than with most other printers, including the other Tandy printers in the overview. If you don't change paper widths much, this probably won't be an issue; but if you do, watch out.

With the tractor positions finally adjusted properly, the DMP 133 had no problems with multipart forms. However, the printer does not handle heavyweight paper well. The bail spring is not strong enough to hold the paper against the roller. When the paper comes to a new page, the fold often slips under the bail, pushes it away

### Tandy DMP 300

#### Fonts & Features

	IBM Proprinter X24			
	Solid	Italic	Sub-Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

from Tandy, but if you plan to use a standard PC parallel cable, you'll need to specify that when you buy the printer.

Aside from the issue of cabling, setting up the DMP 300 is practically mindless. To prepare the printer, you insert the platen knob, mount the paper rack, and load a

# PRINTERS MONOCHROME DOT MATRIX

ribbon cartridge. All that remains then is to load paper in the built-in push tractor, plug in the power cord, and plug the cable into your computer.

As shipped, the DMP 300 wakes up in IBM Proprinter X24 emulation, with the defaults set the way you're most likely to need them. Ask for the menu and the DMP 300 will print the current settings for such items as the default font, pitch, and lines per inch. You can then step through the choices and change them as needed. The DMP 300 also has a Tandy emulation mode that you can set as the default, but this will be of little use to most MS-DOS users.



**TANDY DMP 300**



**FACT FILE**

Tandy Corp. 1800 One Tandy Dr., Fort Worth, TX 76102; (817) 390-3700.  
**List Price:** \$649  
**Dimensions (HWD):** 4.6 x 15.7 x 13.5 in  
**Weight:** 18.5 lbs  
**Emulations:** IBM Proprinter X24, Tandy In Short; Higher priced than other 24-pin, narrow-carriage printers, the DMP 300 is also a bit faster. Despite a few minor quirks, it's a pretty good value

CIRCLE #66 ON READER SERVICE CARD

With its claimed speed of 225 characters per second, the DMP 300 managed 132 cps in draft mode in the PC Labs test speed test, well over the typical result of half the rated speed. In NLQ modes, the printer still managed a respectable 76 cps in its proportionally spaced font and 51 cps in its letter-quality Courier. Draft-quality text is light but still eminently readable. NLQ and proportionally spaced text look as if they could have come from a portable electric typewriter.

In the PC Labs graphics speed tests, the printer clocked in at 96 seconds. Graphics

quality is good, with the printer producing a remarkably smooth curved line and maintaining all the detail of complex patterns. The scanned photograph in the test lost some detail but showed remarkably good resolution and shading for a dot matrix printer.

Front-panel controls include the usual on-line/off-line, line feed, and form feed, along with controls to choose print quality (LQ or draft) as well as pitch (10, 12, or 17) or proportional spacing. Two controls worth special comment are the Quiet and Park buttons.

The Quiet control puts the DMP 300 into a low-noise mode in which the printer uses two passes rather than one to print each line, slowing the printer down somewhat. Unfortunately, a Quiet mode is needed. On PC Labs noise test, the printer measured 76 decibels in normal mode compared with 68 dB in quiet mode. More troublesome is the quality of the sound, which can best be likened to a deep-toned dentist's drill.

The Park control backs up continuous-form paper so that you can feed cut sheets or envelopes without removing the paper from the tractor. The tear-off feature is another nice touch. This advances the paper far enough to let you tear off the continuous-form sheet, then backs up the paper when printing so you can print on the top of the form. Another bonus in paper handling is that the printer had no problems with multipart forms and heavy stock. A 170-sheet, single-bin cut-sheet feeder is available for \$299.95.

The Tandy DMP 300 is a workmanlike printer that offers a good value for the dollar. There are no special features to get excited about, but if you're looking for a 24-pin printer with IBM Proprinter X24 emulation and your budget is limited to \$649, solid value should be enough.

## Tandy DMP 442

by M. David Stone

Even from a distance, one can see a clear familial similarity between the Tandy DMP 442 and Tandy's DMP 300 and DMP 2102. Not only do all three printers share a similar physical design, but the front panels of the DMP 442 and DMP 300 are nearly identical, while the DMP 442 footprint and height closely match those of the DMP 2102. However, the wide-car-

riage DMP 442 is from the 9-pin branch of the family, and the difference shows—in print quality, in speed, and in the \$699 price.

Surprisingly, differences in print quality among the three printers are relatively minor, affecting resolution rather than readability. For example, the DMP 442's O's are slightly squared in comparison to the smoothly rounded O's in Tandy's 24-pin printers. Although not as good as some others in this roundup, the NLQ text is crisp and dark, with solid characters. Draft-quality output shows the telltale individual dots but is still thoroughly readable.

Tandy DMP 442		IBM Proprinter XL 9-pin			
Fonts & Features		Bold	Italic	Sub Super	Underline
10 cpi					
12 cpi					
Compressed					
Proportional					

The Proprinter-compatible graphics output from the DMP 442 is acceptably dark in solid areas, and it retained the detail on the larger patterns in PC Labs' graphics tests. The more-intricate patterns were nearly solid, and the scanned photograph had a slightly posterized effect, but that's primarily a limitation of the particular printer that was being emulated. Both text and graphics quality were as good as you have any right to expect from a 9-pin Proprinter emulation.

On PC Labs' text speed tests, the DMP 442 gave an impressive performance. It breezed in at a brisk 160 characters per second in draft mode—the fastest wide-carriage 9-pin draft speed in this roundup, a quite respectable 64 cps in proportional space mode, and a still respectable 60 cps in NLQ mode. On the graphics test, the printer clocked in at 37 seconds. You're going to spend a lot less time waiting for this printer than for most.

As with the other Tandy printers in this overview, the DMP 442 needs a specially wired parallel cable that is available from Tandy. Alternatively, you can have the printer modified to accept a standard PC cable. The modification involves soldering jumpers on the printer board, so you

PRINTERS  
MONOCHROME DOT MATRIX

TANDY DMP 442



FACT FILE

Tandy Corp., 1800 One Tandy Dr., Fort Worth, TX 76102; (817) 390-3700.  
List Price: \$699  
Dimensions: 4.6 x 13.5 x 21.75 in.  
Weight: 22.2 lbs.  
Emulations: IBM Proprinter XL. Tandy In Short: At a draft speed of 160 cps, the Tandy DMP 442 is the fastest wide-carriage 9-pin in this roundup, but its print quality doesn't match the best comparable printers.

CIRCLE 662 ON READER SERVICE CARD

won't want to do it yourself. Tandy will charge you \$20 for the job.

Default settings for the DMP 442 are held in nonvolatile onboard memory. As with the DMP 300, you can print a list of the current default settings and change them from the front panel. In emulation mode, you have a choice between the 9-pin IBM Proprinter XL and the printer's native Tandy mode.

Paper handling is one of the DMP 442's better points. The printer's built-in push tractor and friction feed performed flawlessly throughout the battery of PC Labs tests, handling standard paper, heavy-weight paper, and multipart forms without problems. A convenient tear off button located on the front panel lets you advance the paper momentarily so you can rip off a sheet. A park button will back up the fan-fold paper so you can load individual cut sheets. An optional \$299.95 sheet feeder is also available.

The Tandy DMP 442 has a healthy number of assets. Like its 24-pin cousins, it is a good, solid value that does exactly the job it should, with no unpleasant surprises. So if you're in the market for a 9-pin, Proprinter-compatible, wide-carriage printer, the Tandy DMP 442 is well worth your interest.

## Tandy DMP 2102

by M. David Stone

The 24-pin wide-carriage Tandy DMP 2102 is similar in many ways to the narrow-carriage DMP 300. But the kinship is closer to that of fraternal than identical twins. While both printers emulate the 24-pin version of the IBM Proprinter and offer Tandy control codes, they differ in such particulars as print speed, noise level, firmware, and front-panel controls. In short, it's fair to think of the \$999 DMP 2102 as a wide-carriage alternative to the \$649 DMP 300, but it's not simply a wide-carriage version of that printer.

Other than carriage size, the most immediately obvious difference between the DMP 2102 and the DMP 300 is in their control panels. Where the DMP 300 has 4 membrane switches, the DMP 2102 sports 8. And where the DMP 300 has 7 indicator lights, the DMP 2102 has 11. Interestingly, the DMP 2102 offers only one additional feature on its control panel: a top-of-form setting.

For the most part, the extra switches and indicators on the DMP 2102 simply make it easier to use the printer. For example, to go to menu mode with the DMP 300, you have to press the on-line/off-line button while turning on the printer—assuming, of course, that you can remember the right button to press. To go to menu

### Tandy DMP 2102 Fonts & Features

	IBM Proprinter X24			
	Bold	Italic	Subscript	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

mode on the DMP 2102, you hit the Mode button and the menu light immediately turns on. The DMP 2102's approach is clearly preferable.

In the PC Labs graphics speed tests, the DMP 2102 clocked in at about 95 seconds. On the text speed tests, the times varied from 51 characters per second for NLQ mode to 136 cps for draft mode. In all of these tests, the DMP 2102 was marginally

TANDY DMP 2102



FACT FILE

Tandy Corp., 1800 One Tandy Dr., Fort Worth, TX 76102; (817) 390-3700.  
List Price: \$999  
Dimensions (HWD): 4.5 x 21.5 x 13.5 in.  
Weight: 22 lbs.  
Emulations: IBM Proprinter, Tandy In Short: Not as fast as some other 24-pin wide-carriage models, the Tandy DMP 2102 is also not as expensive. Though not exactly a wide-carriage version of the \$649 Tandy DMP 300, the DMP 2102 is similar.

CIRCLE 666 ON READER SERVICE CARD

faster than the DMP 300.

The DMP 2102 is more pleasant to have around than its smaller sibling. You won't need to see the noise-level measurement of 74 decibels to know that the DMP 2102 is a quieter printer. More important is the noise quality, which is a deep-toned scratching sound, as opposed to the high dentist's-drill whine of the other DMP models. In quiet mode, with the printer using only 12 of its 24 pins and two passes for each line, the sound is even easier to live with.

One noise that may drive you from the room is the sound of printing on heavy-weight paper. In this case, the deep scratching sound becomes remarkably similar to the sound of fingernails dragging across a blackboard. Still, the DMP 2102 handled the heavy paper without incident, even though Tandy claims a maximum paper weight of only 24 pounds for the printer. The 2102 also handled multipart forms easily, and without making an objectionable sound.

A friction-feed system and a bidirectional push tractor give the DMP 2102 good overall paper handling. Like the DMP 300, the DMP 2102 has a tear-off feature and a park control; the latter backs up fanfold paper to let you feed a cut sheet or envelope. An optional 170-sheet single-

**PRINTERS**  
**MONOCHROME DOT MATRIX**

bin cut-sheet feeder is also available.

As you should expect from a 24-pin printer, the DMP-2102 offers good print quality. Draft text is light but readable; letter-quality characters are dark and fully formed—clearly not Selectric-caliber but

was remarkably good for a dot matrix printer.

One drawback is the Tandy cable problem: namely, you'll have to fork over an extra \$55 to get a specially wired cable for the DMP's parallel port.

The Tandy DMP 2102 is a credible representative of its breed. If you're looking for a wide-carriage, high-quality printer for medium-duty work, the DMP 2102 is definitely a contender.

**If you're looking for a  
wide-carriage, high-  
quality printer, the  
Tandy DMP 2102 is  
definitely a contender.**

essentially indistinguishable from those of a portable electric typewriter. Graphics elements show the same retention of detail, resolution, and shading as that you get with the DMP 300. The curved line in the PC Labs graphics test was notably smooth, and the DMP 2102's scanned photograph

Unisys AP 1324

## Fonts & Features

	Epson LQ-1500			
	Draft	Draft	Sub-Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

er. Epson LQ-2500 emulation is standard, including eight resident fonts: draft, sans serif, Roman, Courier, Prestige, Script, OCR-B, and OCR-A. There are no optional fonts. The print quality on both the character samples and the graphics test was excellent, in part because of the rock-steady paper-feed mechanism.

The AP 1324 has a claimed top speed of 444 characters per second in 10-character-per-inch "Super Draft" mode. Try as I might, I could get only 158 cps from this machine, but that's plenty fast for a 24-pin machine, especially when the Super Draft print matrix—sparser than regular draft—

## Unisys AP 1324

by Bruce Brown

Unisys generally sells printers only to its computer customers, largely Fortune 1000 companies that Unisys reaches through its direct sales force. If you're a member of this group, take advantage of your Unisys connection and check out the \$1,850 Unisys AP 1324, a quiet, wide-carriage, 24-pin dot matrix printer.

The list price includes both Centronics parallel and 25-pin RS-232 serial interfaces, as well as a nonexpandable 8K buff-

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### PRINTERS

### MONOCHROME DOT MATRIX

#### UNISYS AP 1324



**FACT FILE**  
**EDITOR'S CHOICE**

Unisys, P.O. Box 500, Blue Bell, PA 19424; (215) 542-2240  
List Price: \$1,850  
Dimensions (HWD): 8 x 26.5 x 20 in.  
Weight: 44 lbs.  
Emulations: Epson LQ-2500  
In Short: The Unisys AP 1324 is a heavy-duty 24-pin dot matrix printer sold primarily to Unisys customers. It is large, fast, and extremely quiet.

CIRCLE 667 ON READER SERVICE CARD

produces type almost as good as the LQ mode of some 9-pin printers. Regular draft speed was also good, at 117 cps, with NLQ and NLQ proportional modes scoring 66 cps and 72 cps, respectively.

**The Unisys AP 1324 has  
a modern control panel  
with a 20-character LCD  
and LED indicators.**

Standard paper-feed choices include friction feed and an internal push tractor, with a \$105 pull tractor and a \$595 dual-bin cut-sheet feeder available as options. Paper feeds from the rear only. This printer also offers a \$105 color option. The AP 1324's clam-type cartridge ribbons install easily and without mess.

The AP 1324 has a modern control panel with a 20-character LCD, a combination of raised and flush buttons, and LED indicators. The single-button paper-parking function works smoothly.

Other printer vendors might take lessons from Unisys on how to deaden printer sound, for the AP 1324 had an impressively low score of 65 decibels on our noise-level test. Obviously the AP 1324 is intended for corporate offices, where printer noise is anathema, and Unisys has done an outstanding job of meeting this need.

It's a good thing that this machine is sold direct because the availability of an installation team is not just a bonus, it's practically a necessity. In addition to installing the printer's fuse, the user must remove two impossibly stubborn printer-transport screws. The latter may sound like a trivial task, but it's not; even the Unisys-supplied screwdriver can't turn the screws a millimeter.

Transport screws aside, however, the AP 1324 is such a pleasantly quiet and fast wide-carriage 24-pin model that it deserves wider distribution. One thing is certain: a change is needed in the transport screws. How about transport Velcro?

## Unisys AP 1327

by Bruce Brown

If you're already a Unisys system customer, it might make sense to consider this printer; otherwise, move on. The \$450 Unisys AP 1327 is an uninspiring 9-pin dot matrix printer with more than its share of user turn-offs.

Using this printer requires a few additions not included in the list price. First, you must purchase an interface and an emula-

### Unisys AP 1327

### Fonts & Features

#### IBM Proprinter 9-pin

	Bold	Italic	Subscript	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

#### Epson FX

	Bold	Italic	Subscript	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				





# EDITOR'S CHOICE

- **AEG Olympia NP 136-24** (24-pin wide-carriage)
- **Epson FX-1050** (9-pin wide-carriage)
- **Epson LX-810** (9-pin narrow-carriage)
- **Fortis DM 2215** (9-pin wide-carriage)
- **Hewlett-Packard DeskJet Plus** (ink jet)
- **IBM Proprinter XL24E** (24-pin wide-carriage)
- **NEC Pinwriter P2200XE** (24-pin narrow-carriage)
- **Panasonic KX-P1124** (24-pin narrow-carriage)
- **Panasonic KX-P1180** (9-pin narrow-carriage)
- **Unisys AP 1324** (24-pin wide-carriage)

Cheap laser printers will erode the high end of the dot matrix printer market next year. This year, however, the dot matrix market remains robust, as evidenced by the 67 dot matrix printers introduced in the last 12 months: 50 monochrome, reviewed in this section, plus 15 color-capable printers and 4 portable printers that are reviewed in separate sections.

Within the monochrome dot matrix market, you'll find these segments: 9-pin narrow-carriage printers, with list prices between \$230 and \$600 and draft speeds of 40 to 130 characters per second; 9-pin wide-carriage printers (\$350 to \$800, 50 to 160 cps); 24-pin narrow-carriage printers (\$500 to \$900, 30 to 130 cps); 24-pin wide-carriage printers (\$800 to \$1200, 80 to 160 cps); and high-end, high-volume, high-speed printers (around \$2,000, 120 to 260 cps). (All speeds indicated here are the results of PC Labs tests, not the vendors' inflated claimed rates.) We've made Editor's Choice selections in each of these categories. Look, too, at the color dot matrix Editor's Choices; often the color model is the vendor's top-of-the-line dot matrix printer.

At the low end, Epson's \$299 LX-

810 and Panasonic's \$300 KX-P1180 are the best bargains. With street prices under \$200, these 9-pin narrow-carriage printers offer superior combinations of speed, print quality, and paper handling. The Panasonic has a bold proportional font that the Epson lacks, but the Epson prints faster: 94 cps to the Panasonic's 59 cps in draft. Both are ideal for local personal use in offices (especially with a laser to back you up for important documents), for light-duty-cycle forms printing, and for after hours home-office use. Choose the Epson for speed, the Panasonic if you need proportional spacing.

Among wide-carriage 9-pin printers, two stand out. The bargain is the \$599 Fortis DM 2215. Along with good text quality, it prints quickly at a draft speed of 132 cps. One drawback: our test unit tended to jam. The \$799 Epson FX-1050 is also an excellent choice. Its higher price tag buys you more speed—141 cps in draft—and more-reliable paper handling than the Fortis. Honorable mention goes to the \$699 Tandy DMP 442; at a draft speed of 160 cps, it's the fastest wide-carriage 9-pin in this roundup, but its print quality doesn't match that of the leaders.

Two narrow-carriage 24-pin dot matrix printers merit Editor's Choice: the \$499 NEC Pinwriter P2200XE and the \$530 Panasonic KX-P1124. At respective draft speeds of 95 and 87 cps, both offer good, crisp text output. The Panasonic has only one inconvenience: its front panel is a bit complicated; give yourself at least half an hour to get accustomed to it. Although the NEC's paper handling could use some improvement, the printer produced some of the best graphics we've seen in this class of printer on the PC Labs half-tone test. We don't recommend printing scanned photos with a dot matrix printer, but halftones do a better job highlighting differences in graphics abilities among printers.

Two wide-carriage 24-pin printers received Editor's Choice: the \$799

AEG Olympia NP 136-24 and the \$1,199 IBM Proprinter XL24E. Both offer good text output, with the advantage going to the AEG. The IBM's higher price will get you faster speed: 159 cps to the AEG's 118 cps.

In the high-volume, high-speed race, the winner is the 24-pin, wide-carriage, \$1,850 Unisys AP 1324, sold primarily to Unisys computer customers. Less expensive than its competitors, though not as fast, it offers by far the best output, and it's quiet. Honorable mentions go to the \$1,995, 9-pin, wide-carriage, 267-cps Output Technology 560DL and the \$1,999, 8-pin, wide-carriage, 238-cps Seikosha BP-5460.

Whichever dot matrix printer you buy, we strongly recommend a cut-sheet feeder. They're cheap—often just \$200. Five years ago, daisy wheel sheet feeders were \$1,000 and more. Sheet feeders give access to a near-infinite paper supply—located in the cabinet next to the office photocopier.

Among high-quality dot matrix printers, the best output doesn't come from a dot matrix but from an ink jet. With a list price of \$995 and a street price approaching \$700, Hewlett-Packard's DeskJet Plus has the best output of any printer under \$1,000 and the best output of any nonlaser PC printer we've ever seen. The DeskJet Plus is also pretty swift: it prints at 2 pages per minute, or 133 cps. Of course, it doesn't offer the paper-handling capabilities—like automatic envelope printing, impact printing for multipart forms—for which some users buy dot matrix printers. By default, it includes a cut-sheet feeder. Unlike earlier DeskJets, the DeskJet Plus's ink doesn't smear—unless you get it wet. So keep your coffee cup at bay. If your budget calls for a printer between \$500 and \$1,000, the DeskJet Plus is your best bet. However, with the advent of lasers with \$1,000 street prices, once you're in this price range, you should look at products like the Hewlett-Packard LaserJet Series IIP, an Editor's Choice in the laser section.

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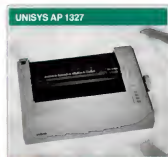
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### PRINTERS MONOCHROME DOT MATRIX

tion module. Our tested unit came with a \$40 parallel interface and a \$55 Epson/IBM emulation module. You can also get a \$95 serial interface and a \$95 DEC/Unisys emulation module—the latter being of little use in the PC market. So the list price of this printer in usable form is actually \$545.

Unisys also offers a \$100 color option kit that lets the AP 1327 respond to Epson JX-80 color printer commands (not tested here). The Epson FX and IBM Proprinter (9-pin) emulations passed PC Labs tests easily. The print quality is adequate for a 9-pin printer but not exceptional. Though the AP 1327's claimed speed is 270 characters per second in 10-characters-per-inch draft mode, it scored 124 cps in draft mode



**PC MAGAZINE FACT FILE**

Unisys, P.O. Box 500, Blue Bell, PA 19424; (215) 542-2240

List Price: \$450

Dimensions (HWD): 5.75 x 18 x 14 in.

Weight: 20.2 lbs.

Emulations: Epson FX-80, IBM Proprinter (9-pin).

In Short: The Unisys AP 1327 is an adequate single-user, 9-pin, narrow-carriage printer. Buying it makes sense only if you're already a Unisys customer. Otherwise, many other vendors make printers that are equally fast, produce equal or better characters and graphics, and cost less.

CIRCLE 468 ON READER SERVICE CARD

and 38 cps in both NLQ and NLQ proportional modes on our tests.

The only resident typefaces include 10-cpi Pica, 12-cpi Elite, and a 10-cpi NLQ font. There is no provision for font cartridges, and the nonexpandable 8K buffer doesn't allow much room for downloaded fonts. You can enhance the print with the normal Epson FX or IBM Proprinter commands.

The AP 1327's control panel uses membrane buttons and LED indicators. There's an automatic paper-loading feature but no paper parking. Paper is fed from the rear for either pressure-feed or internal-push-tractor operation. The \$150 optional cut-sheet feeder can hold 100 sheets.

One piece of good news is that the AP 1327 scored an impressive 70 decibels on the PC Labs noise-level test; such quietness is ideal for Unisys's typical corporate user environment.

Unisys doesn't expect to sell many AP

●

**The Unisys AP 1327  
offers flawless Epson  
FX and IBM Proprinter  
emulations. And, with  
an optional color kit,  
the AP 1327 will also  
respond to Epson JX-80  
printer commands.**

●

1327s to people who aren't already Unisys customers. Most Unisys end users will have someone else set this printer up for them, saving them the necessity of installing the interface and the emulation module, selecting and installing the correct system fuse, and finding binders for the loose two-hole-punched pages of the manuals. Perhaps the Unisys sales force also provides a translation for the Spanish sentence printed on the unit's cover, "No reventar protector frontal con impresora en marcha." (Roughly, "Don't remove the cover when the printer's printing.")

No matter what its assets or drawbacks, the Unisys AP 1327 just isn't competitively equipped or priced. As a convenience printer for workstations, terminals, or network-linked PCs, it has a place, but only in companies that buy all their hardware from one vendor to avoid compatibility problems and to be sure they know whom to go to when something goes wrong. For others, buying this printer makes little sense.

## Axonix LiteWrite

\$529 9-pin dot matrix with internal battery



Text Speed: **BEST QUALITY** 50 cps / 15 cps  
0 50 100 150 200 cps

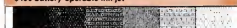
Graphics Speed: **BEST PERFORMANCE** 3 min. 19 sec. / 0.3 gppm  
0 .1 .2 .3 .4 .5 .6 gppm



Once you've torn down  
laws in the country  
yourself face to face  
Devil, what will you  
10CPI Bold Underline  
NLQ 10CPI Bold Underline  
10CPI Bold Underline

## Kodak Diconix-150 Plus

\$499 battery-operable ink jet



Text Speed: **BEST QUALITY** 70 cps / 31 cps  
0 50 100 150 200 cps

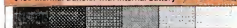
Graphics Speed: **BEST PERFORMANCE** 2 min. 26 sec. / 0.4 gppm  
0 1 2 3 4 5 6 gppm



Once you've torn down all  
laws in the country and  
yourself face to face with  
Devil, what will you hide  
12CPI Bold Underline (compressed)  
NLQ 10CPI Bold Underline  
Proportional 10CPI Bold  
ded

## Toshiba ExpressWriter 301

\$489 thermal transfer with internal battery



Text Speed: **BEST QUALITY** 16 cps / 16 cps  
0 50 100 150 200 cps

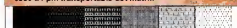
Graphics Speed: **BEST PERFORMANCE** 2 min. 19 sec. / 0.4 gppm  
0 .1 .2 .3 .4 .5 .6 gppm



Once you've torn down  
laws in the country  
yourself face to face  
Devil, what will you  
Draft Bold Underline  
Italic Bold Underline  
Proportional Bold Underline

## Toshiba ExpressWriter 311

\$589 24-pin transportable dot matrix



Text Speed: **BEST QUALITY** 73 cps / 35 cps  
0 50 100 150 200 cps

Graphics Speed: **BEST PERFORMANCE** 1 min. 43 sec. / 0.6 gppm  
0 1 2 3 4 5 6 gppm



Once you've torn down  
laws in the country  
yourself face to face  
Devil, what will you  
Draft Bold Underline  
Prestige Bold Underline  
Proport 12CPI Bold Underline

# What's even more amazing is its letter quality.



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The ExpressWriter 301 is the perfect traveling companion to what is already the world's widest line of truly portable PCs. It operates on rechargeable batteries and AC power. It's small enough to fit into the average briefcase. And it uses 24-dot technology to produce remarkably high resolution type. But most amazing of all, it weighs just four pounds.

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*ExpressWriter 301: 4 lbs., AC and battery-powered, letter-quality 24-dot print head, 60xps draft, Toshiba/Quercus and Epson LQ emulations, 5 resident fonts, exceptional reliability, parallel interface.*

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**TOSHIBA**

Toshiba America Information Systems, Inc., Computer Systems Division  
CIRCLE 321 ON READER SERVICE CARD

PORTABLE PRINTERS  
**ON-THE-ROAD  
OUTPUT**

What weighs  
less than 5 pounds,  
costs less than \$500,  
and prints black  
and white all over?  
A battery-operated  
portable printer!

*by Steve Lewiski*

You're on a trip, typing away contentedly on your laptop computer. You finish your project, save it, and type "print." Nothing happens. You have entered Laptop Hell: you can take your computing power wherever you go, but once your work is done you can't do anything with it.

The obvious answer is that you need a portable printer to go with your portable PC. To aid in your search, we've found four printers that are candidates for traveling in your suitcase and getting your work from screen to paper.

Welcome to our portable printer section, new this year. Not just any small printer fits into this category. To qualify for review in this section, the printer has to be designed with transportation in mind. It must be compact in size and light in weight—preferably under 5 pounds. Carrying a 10-pound laptop or a 10-pound printer might be no big deal, but lugging them both around can make you wish you'd spent the last 3 years working out in the local gym. Or worse, you'll wish you'd never left home in the first place.

So who are you, and why do you need a portable printer? Our study revealed that most portable printer users can be classified into three groups. The largest category includes users who need just one or two copies of each transaction, or professionals who are constantly on the move, such as salespeople, real estate agents, or insurance brokers—workers whose jobs mandate frequent remote output. The second group, a subset of the single-copy users, consists of executives, educators, engineers, and writers who have only an occasional need for output on the road. Finally, there are travelers who require multipart forms processing or signed documents. Such users range from salespeople who create on-site orders that require a customer's signature, to freight forwarders who need signed, detailed bills.

What the three groups have in common is a desire for low price, acceptable speed, and reasonably high-quality output. Some users on the road, however, are under particular pressure to churn out sales reports in a hurry. Generally, they're more sensitive to the printer's speed and price than to output quality. Another purchasing factor is battery operation—which most users consider an advantage but not a necessity, since most portable printing actually takes place near an electrical outlet.

For this year's portable section, we've assembled a lineup of printers from the major portable manufacturers: the Axonix

LiteWrite, the Kodak Diconix 150 Plus, and the Toshiba ExpressWriter 301 and 311. We've chosen to include the transportable Toshiba ExpressWriter 311 in this section even though its 11-pound weight disqualifies it as a portable by our standards. Although it doesn't offer battery operation, it has clearly been designed with traveling needs in mind. We chose not to review the \$495 HP ThinkJet because it hasn't changed much since we reviewed it in 1984; the only recent enhancement is a new printhead that lets it use plain rather than treated paper.

If you think this cast of characters is sparse, you're right. In fact, there are so few portable printers out there that, except for HP and Kodak, only one portable printer exists in each category of print technology: 9-pin and 24-pin dot matrix, ink jet, and thermal. But this is a young market that will respond to user needs in the year ahead. Watch for print enhancements in each niche to blossom as more manufacturers scramble for market share. We'd all like to see an abundance of portable printers help turn the world of travel computing into Laptop Heaven.

## Axonix LiteWrite

by Steve Lewiski

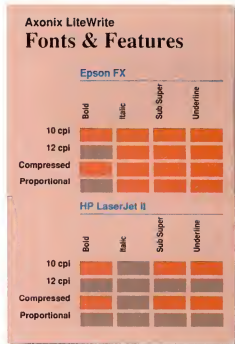
The \$449 Axonix LiteWrite is portable in the truest sense of the word. This 9-pin narrow-carriage dot matrix printer weighs in at just over 4 pounds. Adding the internal rechargeable battery pack pushes the price up to \$529 and the weight to just under 5 pounds. And your on-site options don't end there. The printer can also be powered and recharged using its AC charger/adaptor or from a 12-volt DC power source using the optional MobileCharge adaptor, for an additional \$129.

This smart traveling companion emulates both the Epson FX-100 and the 9-pin IBM Proprinter. Between the two DIP-switch-selectable operating modes, the LiteWrite is capable of printing 14 different character sets, 96 ASCII characters, and italics, along with an assortment of standard print modes. You can also print bit image data in single, double, and quadruple density. Or you can choose from four CRT-compatible densities for graphic applications.

Although the PC Labs text speed test clocked the printer at a reserved pace of 50

cps in draft mode for both emulations, both the draft and NLQ print samples were acceptable in quality. The graphics speed test revealed a marked difference in performance between the Epson and IBM models: in Epson mode, the LiteWrite completed the scanned photo 2.5 minutes; in IBM mode, it took over 3 minutes—the slowest graphics test score in the portable arena.

A boon for maintenance-conscious users, the LiteWrite uses the Brother M-1109 print mechanism and ribbons, with either a Sanyo AE or a General Electric nickel cadmium battery pack. The battery pack lasts about 50 minutes during normal operation. When the charge runs low, the power lamp on the control panel begins to flash, signaling that the battery is half discharged. The battery can be then recharged during use if necessary. The battery packs go a long way: they can be recharged over 1,000 times. When they finally fade, replacement packs are available for \$80.



Operation is quite simple. Loading cut-sheet forms, fanfold paper, multipart forms, and paper rolls (with the addition of the \$25 optional paper roll holder) is a breeze. Axonix claims the LiteWrite can handle six-part forms and paper weights up to 60-lb. card stock. We tested a four-part carbon form and 40-lb. card stock without a problem. If your general application requires using multipart forms thicker than three pages, however, you may have to remove the top cover and adjust the cam levers. This will ensure that there is enough space between the printhead and platen for



# PRINTERS PORTABLE

## AXONIX LITEWRITE



## PC FACT FILE



Axonix Corp., 2257 South 1100 East, Suite 2C, Salt Lake City, UT 84106; (801) 466-9797.

List Price: \$529 (including internal rechargeable battery).

Dimensions (HWD): 4.25 x 13 x 8 in.

Weight: 4.95 lbs. (including battery)

Emulations: Epson FX-100, IBM Proprinter 9-pin

In Short: One and a half pounds lighter than the Axonix ThinWrite, the LiteWrite is a bit slow but handles multipart forms and heavy card stock very well. A good choice for the salesperson who needs to print order forms.

CIRCLE 603 ON READER SERVICE CARD

Considering that most of the LiteWrite's battery-powered portable competitors are of the thermal or ink jet mold, its ability to print multipart forms might be its most unique and valuable feature. This rugged "will travel" printer is made for the salesperson with field order responsibility.

## Kodak Diconix 150 Plus

by Steve Lewis

Kodak's experience in the battery-powered printer market has certainly paid off with the release of the Diconix 150 Plus. By incorporating several new and improved features into its predecessor, the Diconix 150 (reviewed in our printer issue of November 11, 1986), Kodak seems only to have ensured its prevalent market position. With a price tag of \$499 for the parallel and \$519 for the serial version, this sleek little ink jet is a competitor's nightmare.

Possibly the most important addition the 150 Plus brings is its DIP-switch-selectable expanded graphics mode. When activated, this mode makes available 10-pitch fonts and full-size graphics for the production of true letter-quality documents. By contrast, in normal operating mode, 12 pitch is standard, and graphs are automatically reduced by 25 percent.

The graphics mode feature is only the beginning of the design and operational improvements. In order to improve the performance and flexibility of the Diconix printer, Kodak has incorporated a 20 percent increase in print speed, basic font selection through the control panel, a new ink that allows you to print on plain paper, and a 9.5-inch-wide paper exit slot so that continuous form-feed paper can be used with the cover closed. For the world traveler, the number of international character sets has been expanded from 8 to 14.

Because the 150 Plus is compatible with the Diconix 150, the Epson FX series, and the 9-pin IBM Proprinter, users should have no trouble taking advantage of the improved text and graphics capabilities of this device. The PC Labs text and graphics speed tests revealed little variation in time or quality during both emulations, so mode selection truly depends on the user's preference. Selection between

the Epson or IBM operational mode is easily done by flipping a DIP switch located just under the top cover.

In addition to this ink jet's commendable print quality in its three graphics densities (single, double, and quadruple) and four text modes (draft, NLQ, quality, and condensed), the 150 Plus churned out 70 cps in draft mode and 31 cps in NLQ during our text speed tests, making it the fastest of the three under-5-pound portables in this section—quite impressive for a printer that measures a scant 2 by 10.8 by 6.5 inches. On the scanned photo test, the 150 Plus got the second-fastest score among the lightweight portables—it printed the halftone image in 146 seconds.

One reason Kodak has been able to keep the 150 Plus so small and light—less than 4 pounds with batteries—is the company's patented platen design. The platen is hollow and is used to house five C-sized nickel cadmium batteries. To recharge the batteries, connect the AC adapter and turn the printer on, then press all three of the

## Kodak Diconix 150 Plus Fonts & Features

Epson FX				
	Bold	Italic	Sub Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				
IBM Proprinter 9-pin				
	Bold	Italic	Sub Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

control-panel buttons until one of the font indicators begins to flash. When the batteries are fully charged, the font indicator stops flashing and the power lamp illuminates. This process takes anywhere from 10 to 14 hours, whether or not the printer is in use. Fully charged, the batteries supply approximately 50 minutes of average operation. Since Kodak does not provide the batteries, the life cycle will vary depending on the quality of battery purchased.

One drawback to the 150 Plus's conve-

the print mechanism to move freely.

The LiteWrite can print 5-, 10-, 12-, and 17-pitch characters in both draft and NLQ modes. Its front control panel allows you to select the NLQ print mode and line feed, and to switch between on- and off-line. The front-panel lights—power, on-line, and NLQ—are self-explanatory, while the check lamp detects paper out, motor, memory, and transmission errors. Software controls further operations, such as choosing bitmapped graphics or mixing print modes. Under the Epson emulation you're allowed to mix up to eight print modes; up to five combinations are allowed during IBM emulation.

If the LiteWrite's features sound familiar, they are. With the exception of removing 1.5 pounds of nonessential weight, mostly from the platen, the LiteWrite is technically the same printer as the Axonix ThinWrite 100, reviewed in the printer issue of November 10, 1987. The ThinWrite 100 is still available for \$499 with batteries and \$419 without. Wondering whether reducing the printer's weight has increased its vulnerability? Stop wondering. Axonix backs both of these printers with standard 1-year and optional 4-year extended parts-and-labor service warranties.



# PRINTERS PORTABLE

## KODAK DICONIX 150 PLUS



### PC MAGAZINE FACT FILE EDITOR'S CHOICE

Eastman Kodak Co., Personal Printer Products,  
901 Elm Grove Rd., Rochester, NY 14653-6201;  
(800) 255-3434.  
**List Price:** Parallel version, \$499; serial version,  
\$519 (not including batteries).  
**Dimensions (HWD):** 2 x 10.8 x 6.5 in.  
**Weight:** 3.75 lbs. (including batteries).  
**Emulations:** Diconix 150, Epson FX, IBM  
Proprinter 9-pin  
**In Short:** The handsome packaging of the  
Diconix 150 Plus foreshadows the excellence of  
its performance. This narrow-camage ink jet  
printer combines speedy, high-quality output with  
a sleek battery-powered design, making it a  
superb choice for personal, office, and limited  
road use. Improvements over the Diconix 150  
include the switch-selectable expanded graphics  
mode and the ability to print on plain paper.

CIRCLE 604 ON READER SERVICE CARD

nient size is a maximum print width of 7.1 inches. If the width of a file exceeds the print limit, additional text will wrap and graphs will be truncated. Although this may sound serious, there are two easy ways around it. If text wrapping is encountered or a 10-pitch character is required, you can reset the margins in your word processor. If a graph is larger than 7 inches or a 12-pitch character is suitable, simply flick the expanded graphics mode DIP switch off. Reset the printer by powering it off, then on, and you'll be in the default mode, where characters are printed at a maximum of 12 pitch and graphic images are automatically reduced by 25 percent. The printer also manages a 19.2-pitch condensed mode, which produces 136 characters per line.

Printer operation is delightfully simple. It's made even easier by the addition of the enclosed *Fast Track Operating Guide* and the detailed reference manual. The informative control panel includes various status LEDs and three switches to control on- and off-line status, line- and form-feed, as

well as font mode selection.

The 150 Plus handles either single-sheet or continuous fanfold paper up to 24 pound stock. This reported limitation may be artificial—we tested 40-pound card stock with no problems. To install the ink jet cartridge, just lower the latch, insert the cartridge, and slide the latch back to the upright or home position. Even though the physical cartridge used in the 150 Plus is the same as in other ink jet printers, the ink is different. To ensure higher-quality output, the manufacturer suggests purchasing its replacements for \$13.95. The use of ink jet paper will also increase the quality of output but is not required.

Improving on the already popular Diconix 150, the Diconix 150 Plus is a superb choice for the professional who requires quality output quickly. Just toss this tiny lightweight portable into your briefcase, and off you go.

## Toshiba ExpressWriter 301

by Steve Lewis

Toshiba's entry into the battery-powered portable printer arena has so many positive attributes that it should be a top pick. The \$489 Toshiba ExpressWriter 301 is silent as the grave, weighs just 4 pounds, and produces superb output. Unfortunately, it prints text at such a turtlesque speed that for many applications it's not even in the running.

This is one portable printer that won't be issued any speeding tickets. In the PC Labs text speed test the 301 crawled along, yielding only 16 cps in both draft and quality print modes. With virtually no difference in the output rate, I'd advise you to use the higher-quality print mode for all documents. If you produce a lot of graphs, the news is more encouraging. In the graphics speed test, the 301 produced our scanned photo in 139 seconds while in high-speed mode—the fastest of the three under-5-pound portables.

The 301's poor text speed performance brings one benefit: peace and quiet. On the PC Labs noise level test, the 301 rated at less than 47 decibels—lower than most other dot matrix printers in this issue.

Speed aside, the 301 is a fascinating machine. While incorporating most of the basic operating features of its competitors,

this printer also employs a 24-element nonimpact thermal printhead—certainly not one of the industry standards. By combining a thermal printing process with the use of film heat transfer cassettes, the 301 is able to print on ordinary paper. To keep output quality consistent, Toshiba has added a density control knob.

## Toshiba ExpressWriter 301 Fonts & Features

	Epson LQ-1500			
	Bold	Italic	Sub Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

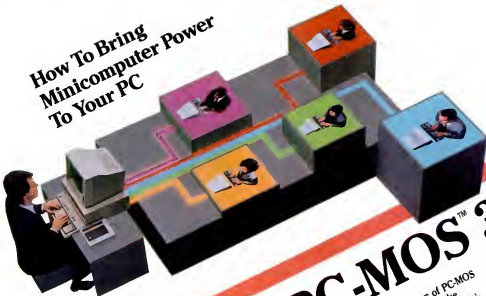
The resident emulation modes, Epson and Toshiba/Qume, are DIP-switch selectable and allow software compatibility with the Epson LQ850, Toshiba P321SL, and Qume 11 printers. Both emulation modes will support three resident typefaces—Courier, Prestige Elite, and Draft—as well as numerous downloadable fonts from the Toshiba font library.

Proportional spacing, doublestrike, bold italics, condensed, and enlarged print are available in four standard pitches: 5 (enlarged), 10 (pica), 12 (elite), and 16.7 characters per inch (condensed). Three graphic densities are available, ranging from 180 by 180 dots per inch for single density up to 360 by 360 for quadruple. The straightforward user manual contains a full list of selectable commands and options along with their respective control sequences.

Among the 301's unique features is its battery pack. Unlike the other portables' batteries, this one is not user replaceable. This should present few problems, as Toshiba claims its battery can be recharged up to 2,000 times. A low-battery lamp on the front control panel lights up when the battery requires charging. The recharging process takes about 8 hours and supplies enough power to operate the printer for approximately 1 hour. One troublesome aspect is that charging this battery for over 8 hours can damage it, imposing some constraints on the user.

The compact, enclosed design of the 301 makes preparation for transportation practically effortless. Just close the sheet

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## TOSHIBA EXPRESSWRITER 301



## FACT FILE

Toshiba America Inc., Information Systems Division, 9740 Irvine Blvd., Irvine, CA 92718; (800) 457-7777.

List Price: \$489 (including battery).

Dimensions (HWD): 7 x 12.5 x 5.5 in.

Weight: 4 lbs. (including battery).

Emulations: Epson LQ, Toshiba Qume.

In Short: The Toshiba ExpressWriter 301 employs a 24-element thermal print device to produce crisp, clear characters on plain paper. Unfortunately this narrow-carriage portable is terribly slow.

CIRCLE 806 ON READER SERVICE CARD

## PRINTERS

## PORTABLE

## Toshiba ExpressWriter 311

by Steve Lewicki

It's true that the \$589 Toshiba ExpressWriter 311 weighs 11 pounds and doesn't have a battery, but don't be discouraged. This transportable (luggable) impact printer brings along speed and extra features that could turn out to be lifesavers at temporary work sites.

The 24-pin dot matrix ExpressWriter 311 supports its Epson LQ series, IBM Proprinter, and Toshiba/Qume emulations via DIP-switch selection. Also included are three resident typefaces: Courier, Prestige Elite, and High-Speed Draft. Like the other portables tested, this one offers proportional spacing; doublestrike; bold, italics, condensed, and enlarged print; as well as single-, double-, and quadruple-density graphics, along with a variety of international character sets and the ability to use downloadable fonts.

Unlike its portable cousins, the 311 offers the ability to mix and match these modes with 14 different easy-to-use font cards (\$79 each), allowing you to produce a larger array of type styles for your professional-quality documents. Print ranges of 5, 10, 12, 15, 16.7, and 20 pitch can be obtained through different manipulations of print modes.

The 311 offers exceptional paper-hand-

guide, unplug the cable and AC adapter, and you're set. As for paper handling, the 301 can handle single cut sheets of up to 40-pound stock flawlessly, while continuous fanfold paper tends to drift a bit to the left. This is due in part to the absence of a tractor feed; align very carefully to prevent problems. Another missing function is form-feed; you have to either advance the paper one line at a time through the line feed button or else turn the platen knob.

The rest of the 301's operations are much smoother than its fanfold loading process. The \$4.50 film heat transfer cassette ribbons simply snap into place and can be reused up to five times. This suggestion applies only to draft copy, as the print quality deteriorates with each subsequent pass of the ribbon. The tidy control panel contains three buttons: high/low speed, line feed, and select, which controls the on-line mode. In addition, five LEDs provide distinct information about the 301's operating status.

Even though the Toshiba ExpressWriter 301 produces top-quality output, is easy to use, runs on battery power, and is light and compact, its dreadfully slow text speed can't be overlooked. Unless your requirements include practically silent operation, the 301 is hard to recommend.



## EDITOR'S CHOICE

• Kodak Diconix 150 Plus

In this brand new portable printers section, we reviewed three under-5-pound battery-operated portables (the Axonix LiteWrite, the Kodak Diconix 150 Plus, and the Toshiba ExpressWriter 301) and one 11-pound batteryless transportable (the Toshiba ExpressWriter 311). Among the true portables, the Diconix 150 Plus shines. In a somewhat heavier class of its own, the ExpressWriter 311 rates an honorable mention.

When it comes to price and weight, the three portables are closely matched; they all cost around \$500, and they all weigh between about 4 and 5 pounds. The differentiating factors are text speed and output quality.

The ink jet Kodak Diconix 150 Plus is by far the fastest battery-operated portable printer in this roundup, and the clear winner for on-the-road output. Twenty percent quicker than the earlier Diconix 150, the 150 Plus clocked in at 70 cps in draft mode and 31 cps in NLQ—roughly twice as fast as its two competitors. Toshiba's thermal transfer ExpressWriter 301 produces slightly better print quality, but at 16 cps in draft and quality modes, it's just too slow.

Honorable mention goes to Toshiba's 24-pin dot matrix ExpressWriter 311. At 73 cps in draft and 35 cps in quality, this transportable (luggable) model is swifter than any of the portables reviewed here. And weighing 11 pounds, it's about 2 pounds lighter and a bit smaller than the average 9-pin narrow-carriage dot matrix printer reviewed in this issue. The 311 is a good choice for personal, office, and limited road use.

ding capability. The removable snap-in forms tractor ensures an uninterrupted flow of fanfold paper. A built-in single-sheet guide complements the autoloader feature, which automatically feeds single sheets to line up with the printhead at the top of the page. Although the 311 is rated for 21-pound paper and three-part forms, 40-pound stock and four-part multipart

Toshiba ExpressWriter 311  
Fonts & Features

IBM Proprinter 24-pin				
	Bold	Italic	Sub-Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				
Epson LQ-1500				
	Bold	Italic	Sub-Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

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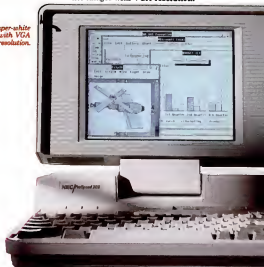


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#### PRINTERS

#### PORTABLE

#### TOSHIBA EXPRESSWRITER 311



#### PC FACT FILE

Toshiba America Inc. Information Systems Division, 9740 Irvine Blvd., Irvine, CA 92718; (800) 457-7777

List Price: \$589

Dimensions (HWD): 4.5 x 17 x 12.75 in.

Weight: 11 lbs

Emulations: Epson LQ, IBM Proprinter, Toshiba Qume.

In Short: Too heavy and lacking a battery, the 311 isn't really a portable. But this transportable produces first-rate professional documents quickly. If you don't let the weight get you down and you don't need battery operation, the 311 is ideal for personal, office, and limited road use.

CIRCLE 666 ON READER SERVICE CARD

forms glide through without difficulty. A copy-control lever, conveniently located inside the printer, allows you to make adjustments for optimum print quality depending on the thickness of the paper or forms you are using.

Another outstanding feature is the 311's standard 16K print buffer, four times larger than that of its competitors. For an additional \$99 you can purchase a 32K memory expansion card, which plugs easily into the card slot. Once the card is installed you can use either 32K with downloadable fonts or all 48K as a print buffer. In any case, it's certain to reduce waiting time during large print jobs.

On all PC Labs speed tests the 311 was faster than any of the under-5-pound portables reviewed here. The 311 handled our text speed test at 73 cps in draft and 35 cps in quality mode in both Epson and IBM Proprinter emulations. In the graphics speed test, the 311 printed the halftone image in 90 seconds for the Epson and 104 seconds for the Proprinter. The text print quality was impressive for its class, especially in the draft and NLQ modes. As for

graphics, the dark shaded areas of the graphs fluctuated slightly in density, a small sacrifice for the 311's commendable performance. All tests were performed using the printer's standard 16K print buffer.

The 311 uses standard snap-in cloth ribbons that can be replaced for \$13.50. The remainder of the printer's operation is as easy as installing its ribbon. Buttons on the informative front panel control basic printer functions such as off-line, line, and form feed, pitch and font selection. There is even a switch that controls normal and quiet print modes. Thanks to the superb acoustical design, most people will find little use for the latter. There are also eight LEDs to indicate the printer's current operating status.

Toshiba has designed the 311 with transportation in mind, making sure that every loose cord and all covers lock into place. This construction also makes the 311 easy to store securely even in fairly cramped conditions.

Admittedly, it's not the tiniest portable

It's not the tiniest portable around. But

the Toshiba ExpressWriter 311 is a good bet for users who want a printer that's transportable, space-efficient, and capable of quality type.

printer around. But the Toshiba ExpressWriter 311 is a good bet for users who require a printer that's durable, transportable, space-efficient, and capable of quickly outputting a complete spectrum of documents from draft to quality multistyle type. It's ideal for use in the home, at school, and at temporary work sites. If you're searching for a portable printer and can't compromise on features, don't let the poundage of the ExpressWriter 311 intimidate you. You'll quickly get used to it. ■



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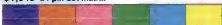
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## AEG Olympia NPC 136-24

\$1,049 24-pin dot matrix



Once you've torn down  
 laws in the country and  
 yourself face to face wit  
 Devil, what will you hide  
 Draft Bold Underline Com  
 Courier Bold Underline  
 Proportional Bold Under

## AMT Accel-500

\$1,485 24-pin wide-carriage dot matrix



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 Devil, what will you  
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 Courier Bold Underli  
 Proportional Bold Under

## AT&T 583

\$1,295 24-pin wide-carriage dot matrix



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 Courier Bold Underli  
 Proportional Bold Under

## Brother M-1809

\$627 18-pin dot matrix



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 LQ Bold Underline Co

## Brother M-1824L

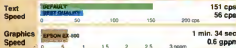
\$827 24-pin dot matrix



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 Devil, what will you  
 Draft Bold Underline  
 Brougham Bold Underl  
 Proportional Bold Under

## Citizen HSP-500

\$578 9-pin dot matrix



Once you've torn down  
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 Devil, what will you h  
 Pica Bold Underline  
 NLQ Roman Bold Under  
 NLQ Roman Proportiona

**Citizen HSP-550****\$798 9-pin wide-carriage dot matrix**

Text Speed **DEFAULT** **BEST QUALITY** 156 cps  
0 50 100 150 200 cps 56 cps

Graphics Speed **EPSON EX-400** 1 min. 34 sec.  
0 0.5 1 1.5 2 2.5 3 gppm 0.6 gppm



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Elite Bold Underline Compress  
NLQ Roman Bold Underl  
NLQ Sans Serif Proport

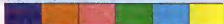
**PC C. Itoh C-610****\$799 24-pin dot matrix**

Text Speed **DEFAULT** **BEST QUALITY** 92 cps  
0 50 100 150 200 cps 50 cps

Graphics Speed **EPSON LX-2000** 3 min. 12 sec.  
0 0.5 1 1.5 2 2.5 3 gppm 0.3 gppm



Once you've torn down a  
laws in the country and  
yourself face to face wit  
Devil, what will you hide  
Courier Bold Underline  
Elite pitch Bold Underli  
Proportional Bold Underl

**Epson LQ-2550****\$1,499 24-pin wide-carriage dot matrix**

Text Speed **DEFAULT** **BEST QUALITY** 105 cps  
0 50 100 150 200 cps 68 cps

Graphics Speed **EPSON LQ-2500** 55 sec.  
0 0.5 1 1.5 2 2.5 3 gppm 1.1 gppm



Once you've torn down  
laws in the country  
yourself face to fac  
Devil, what will you  
Draft Bold Underline  
Courier Bold Underli  
Proportional Bold Underl

**Facit B3550C****\$1,595 18-pin wide-carriage dot matrix**

Text Speed **DEFAULT** **BEST QUALITY** 181 cps  
0 50 100 150 200 cps 45 cps

Graphics Speed **EPSON LX-40** 2 min. 41 sec.  
0 0.5 1 1.5 2 2.5 3 gppm 0.4 gppm



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Devil, what will you  
Pica Bold Underline  
NLQ Pica Bold Underl  
Elite Bold Underline Comp

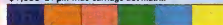
**Fortis DQ4215****\$949 24-pin wide-carriage dot matrix**

Text Speed **DEFAULT** **BEST QUALITY** 100 cps  
0 50 100 150 200 cps 40 cps

Graphics Speed **EPSON LQ-2500** 1 min. 45 sec.  
0 0.5 1 1.5 2 2.5 3 gppm 0.9 gppm



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laws in the country  
yourself face to fac  
Devil, what will you  
Pica Bold Underline  
NLQ Pica Bold Underl  
NLQ Proportional Bold U

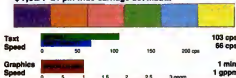
**Fujitsu DL4400****\$1,399 24-pin wide-carriage dot matrix**

Text Speed **DEFAULT** **BEST QUALITY** 121 cps  
0 50 100 150 200 cps 67 cps

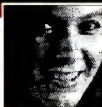
Graphics Speed **EPSON LQ-2500** 1 min. 44 sec.  
0 0.5 1 1.5 2 2.5 3 gppm 0.6 gppm



Once you've torn down  
laws in the country  
yourself face to fac  
Devil, what will you  
Draft Bold Underline  
Courier Bold Underli  
Proportional Bold Underl

**Genicom 1040****\$1,924** 24-pin wide-carriage dot matrix

Once you've torn down  
laws in the country and  
yourself face to face with  
Devil, what will you hide  
Draft Bold Underline  
Elite pitch Bold Underline  
Proportional Bold Underline

**Star Micronics NX-1000 Rainbow****\$379** 9-pin dot matrix

Once you've torn down  
laws in the country and  
yourself face to face with  
Devil, what will you hide  
Pica Bold Underline  
Sans Serif Elite Bold Underline  
Courier Proportional Bold Underline

**Star Micronics XB-2415 Multi Font****\$1,049** 24-pin wide-carriage dot matrix

Once you've torn down  
laws in the country and  
yourself face to face with  
Devil, what will you hide  
10CPI Bold Underline  
NLQ 10CPI Bold Underline  
Times SLQ Proportional Bold Underline





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*by Bruce Brown*

Remember how dazzled you were when *The Wizard of Oz* switched from monochrome to color film? With an inexpensive color dot matrix printer, your colleagues can be just as impressed with your internal reports or business presentations. Sure, a presentation printed in black and white will certainly get your point across, but a color presentation can make an impact that lasts far longer than the meeting itself.

Color dot matrix printing is still in the early stages, just as color monitors were not too long ago. Remember when color monitors were meant for games and educational software only? Today these screens are becoming standard with improved resolution and more-effective color implementation in application software. Color printing with dot matrix printers is in the early stages of software implementation and user acceptance, but as the technology improves and software companies find better ways to use color in computer hard-copy output, color printers will achieve wider visibility as well.

#### COLOR COMPARISONS

Convinced that users are beginning to demand affordable printing technologies, we wrote a brand-new color test for dot matrix printers this year. And although the printing technology isn't different from that of monochrome dot matrices, we've created this special section to help you compare the results of our color test from 15 different dot matrix printers. In "The PC Magazine Printer Guide: Color Dot Matrix Printers," you'll see how each printer in this section produces six colors: blue, red, magenta, green, cyan, and yellow.

Some of the printers reviewed here come standard with color-printing capability. In other cases, vendors honored our request to send optional color kits installed. Of course, some vendors neglected to send us the color option, so you'll find those printers in the monochrome dot matrix section. Some of these printers have 9-pin heads while others have 24-pin, but all are primarily used for regular black printing with color capability as an extra. Don't dismiss these printers as frivolous gimmicks; most offer good to excellent black printing, as well as the ability to print in color. Many of these represent the top-of-the-line printers from their respective vendors.

#### COLOR FOR UNDER \$100

Perhaps surprisingly, adding color-printing capability to dot matrix printers is rela-

tively inexpensive. Color option kits for black-print-only machines usually cost between \$50 and \$100. Four-color ribbons, with equal-width bands of black, yellow, red, and blue that blend to produce up to seven different colors, cost from two to three times as much as black fabric ribbons—more expensive, but not an intimidating premium.

It's no coincidence that color dot matrix technology is currently making a statement; as needs arise, the market responds. Major business uses for color printers have grown to include the production of business graphs and charts as well as hard-copy presentation materials, such as text charts

As color page printing  
becomes more common,  
the demand for  
the color dot matrix  
alternative will  
grow—for draft  
purposes or just as a  
cheaper option.

that increasingly use clip art.

Another valuable use for color dot matrix printing is to create drafts of output that will later be generated by a color page printer. Although color page printers are coming down in price, the ones reviewed in this issue (see "Color Page Printers: Affordable at Last") will still cost you between \$8,000 and \$17,000, whereas some color dot matrix printers cost under \$500.

The equipment, paper, and supply costs for color page printing are still relatively high, with no price breaks in sight at present. Color dot matrix printing requires ribbons that are slightly more expensive than plain black ones, but requires no special paper. Furthermore, as color page printing becomes more common, the demand for less-expensive alternatives will grow, either for draft purposes or just as a cheaper option.

#### QUALITY AND COMPATIBILITY

As with other printers, two factors should most affect your buying decision: print quality and color command set compatibility. In terms of output, look for clear color differentiation; deep, saturated colors with little or no white showing through; and true colors rather than off-shades. The major color control code command sets are for Epson and IBM color printers, with Epson JX-80 color compatibility the most common standard. Your chosen printer may produce gorgeous images, but if the printer doesn't have a common color-printer compatibility, your application software is less likely to have printer drivers that can take advantage of the printer's capabilities.

If you're expecting these wonders to be fast, forget it. Color dot matrix printing is generally much slower than printing black type or graphics, especially if the printhead has to make more than one pass in order to blend the colors. But don't despair too much—once you switch back to all-black printing, these models will return to typical dot matrix speeds.

#### RIBBON REALITIES

Since color ribbons cost more than black ribbons, odds are you'll save money and get better color if you attend to ribbon realities. The color portions of ribbons can dry out, resulting in faded shades. If you print in color only occasionally, it's a good idea to have both four-color and black-only ribbons, keeping the color ribbons in a plastic bag when not in use so they won't dry out prematurely. It's not uncommon to use up the black portion of a four-color ribbon while the color bands still have lots of life.

In the months and years to come, you can look forward to a wide variety of technological advances in color dot matrix printing. Resolutions will go up, the result of higher-pin-count printheads or more printhead passes. Speed will also improve. But the biggest improvement will result from greater implementation of color hard-copy possibilities by software vendors.

Adding color often meets initial resistance. Early PC color monitors with rough CGA resolution were less than pleasant to stare at, but with the much-improved EGA and VGA resolutions, color monitors have gained respectability and added dimensions of clarity and attractiveness to user interfaces and screen presentations. Color printing is just now coming of age and is likely to grow in acceptance as its business functionality becomes more evident.

# PRINTERS COLOR DOT MATRIX

## AEG OLYMPIA NPC 136-24



### PC FACT FILE

**AEG Olympia Corp.**, 3140 Rte. 22, Somerville, NJ 08876, (201) 251-8300.  
**List Price:** \$1,049  
**Dimensions (HWD):** 6.5 x 25.25 x 14 in  
**Weight:** 24 lbs  
**Emulations:** Epson LQ-2500, IBM Proprinter XL24  
**In Short:** The AEG Olympia NPC 136-24 is a 24-pin dot matrix color printer at a good price. It's a bit slow, but you can overlook this shortcoming because of the excellent text and graphics printouts. It also has a very good control panel with a liquid crystal display.

CIRCLE 643 ON READER SERVICE CARD

## AEG Olympia NPC 136-24

by Henry Fersko-Weiss

The AEG Olympia NPC 136-24 makes color printing affordable. At \$1,049, this 24-pin dot matrix entry produces excellent text and graphics output with just a couple of snags in its fabric.

The NPC 136-24 is a little chunky at 6.5 inches high and 24 pounds, but it nevertheless has a fairly compact footprint for a wide-carriage printer. On the top front of the printer is a string of raised buttons that allow you to change font or pitch quickly and easily, to advance the paper by a line or a page, and to go on- or off-line. A Menu button is used to set a myriad of configuration functions, from the emulation and the character set to the interface, baud rate, and auto sheet feeder. The NPC 136-24 prints out the configuration when you press the Font or Pitch button while in configuration mode.

With the Menu key, you can also set up two format menus with items like a default font and pitch, margins, slashed zero, and double-high printing. It's easy to switch back and forth between the menus, but you have to turn the machine off and on, so you can't make the switch while in the midst of printing.

To the left of the control-panel buttons is the 16-character LCD screen that details the button selections you make. The LCD screen is also used for error messages. Because the LCD screen tells you exactly

what is going on, the printer is a cinch to operate. Other indications of what's happening are provided by the four LED lights arrayed above the buttons and LCD screen.

One of the nicest design elements of the NPC 136-24 is its paper handling. The internal tractor feed can both push and pull the paper, and paper parking lets you feed single sheets of paper into a slot in the front without removing the continuous paper. You can also get an automatic single-bin sheet feeder from AEG Olympia for \$299 that can handle 150 sheets at once. A dual-bin sheet feeder costs \$528.

The text and graphics you get from the NPC 136-24 are a joy to the eye. Letters are precisely edged, without the jagged traces of dots you get in less-capable printers. There is only one font for draft print; the other five fonts are all for LQ printing.

Graphics output images are also sharp and clear, and you can even see fine points of shading or delicate lines. The color tends to be slightly dirty in places, but this can be improved somewhat by adjusting a manifold lever that controls the impact of the printhead.

A color ribbon naturally slows the

printer considerably. In IBM Proprinter emulation, the NPC 136-24 clocked in at only 96 characters per second in draft mode and 38 cps in LQ mode. The PC Labs graphic test image took a little over a minute to print in Epson emulation—about twice the time it took AEG Olympia's monochrome 24-pin wide-carriage machine (the NP 136-24, reviewed in this issue) to print the same image.

There is one other problem with the color ribbon. Its greater width caused it to catch below the printhead when printing graphics with just the black strip, as in Proprinter emulation. When this occurs, the paper receives the impact marks of the pins but without ink on the page, whether for a section of the image or for an entire picture. Again, adjusting the manifold lever may help.

The NPC 136-24 has a few foibles, including a slightly high 79-decibel noise level and not-outstanding speed, but it's still a prime candidate for your color printer dollar. With such superior text and graphics output on its side, the 136-24's speed deficiencies are easy to overlook.

## AMT Accel-500

by Elsa J. Hirsch and  
Sharon Terdemian

The \$1,485 AMT Accel-500 offers a lot of nifty features, but it falls short at its main task—printing. In fact, during PC Labs testing, a fellow reviewer walked by and commented, "Not bad for a 9-pin print-

### AEG Olympia NPC 136-24 Fonts & Features

#### Epson LQ-1500

	Bold	Italic	Sub-Super	Underline
10 cpi	■	■	■	■
12 cpi	■	■	■	■
Compressed	■	■	■	■
Proportional	■	■	■	■

#### IBM Proprinter X24

	Bold	Italic	Sub-Super	Underline
10 cpi	■	■	■	■
12 cpi	■	■	■	■
Compressed	■	■	■	■
Proportional	■	■	■	■

### AMT Accel-500 Fonts & Features

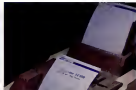
#### Epson LQ-1500

	Bold	Italic	Sub-Super	Underline
10 cpi	■	■	■	■
12 cpi	■	■	■	■
Compressed	■	■	■	■
Proportional	■	■	■	■

#### IBM Proprinter X24

	Bold	Italic	Sub-Super	Underline
10 cpi	■	■	■	■
12 cpi	■	■	■	■
Compressed	■	■	■	■
Proportional	■	■	■	■

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# PRINTERS COLOR DOT MATRIX

## AMT ACCEL-500



## PC FACT FILE

Advanced Matrix Technology Inc., 765 Flynn Rd., Camarillo, CA 93010; (805) 386-5799.  
List Price: \$1,485.  
Dimensions (HWD): 7.5 x 14 x 18.25 in.  
Weight: 40 lb.  
Emulations: AMT, Diablo 630, Epson JX, Epson LQ-2550, IBM Proprinter XL24, IBM 5182 Color Printer, Xerox 4020 Color Ink Jet.  
In Short: Although the wide-carriage Accel-500 handles spreadsheets and multipart forms well, the print quality, though improved slightly from last year's model, still has a way to go before this printer's high price is justified.

CIRCLE 630 ON READER SERVICE CARD

er." Alas, this printer has a 24-pin print-head.

But there is some good news. The wide-carriage Accel-500 operates from a removable credit-card-size IntelliCard that contains the emulations and fonts. This is convenient because, as updates become available, all you have to do is switch cards. The IntelliCard holding bin is easily accessible from the top of the machine. The printer can hold two cards at a time, one of which is standard; its emulations include Epson JX, Epson LQ-2500, IBM Proprinter XL24, IBM 5182, and four fonts: Courier, Elite, Trend, and Gothic. An additional "baker's dozen" font card for \$95 includes all 13 fonts.

Color is standard for the Accel-500, although a monochrome ribbon is available. The color palette comprises black, blue, red, yellow, purple, green, and orange; the colors are saturated but not true. For example, we oohed and aahed over the orange until we printed out the red. The red was so pink that the orange in comparison looked quite reddish. Both monochrome and color ribbons are available from the vendor in \$80 six-packs or separately for \$15 each.

Print quality is not what it should be for a high-end 24-pin printer, and although

AMT claimed in a letter to have fixed the problems mentioned in last year's review of an earlier version (*PC Magazine*, October 31, 1988), this machine still has a long way to go. The draft quality is still drafty—there are too many holes between the dots. The letter quality is better than it was a year ago, but not as good as that of other 24-pin dot matrix printers.

Not all of the emulations offered with the Accel-500 were entirely compatible. The Epson LQ and Epson JX emulations worked well, but the IBM Proprinter XL24 emulation compressed the graphics image. Strangely enough, this printer's best output sample was obtained when we ran the XL24 emulation through our IBM Proprinter 9-pin emulation test. The speed for all text modes was good—especially draft mode, which scored 161 characters per second, but the graphics performance was slow.

The Accel-500 has 12 primary-function buttons and a "Dial-a-Feature" option on the control panel. The Select option lets you scroll through 49 categories to set printer options such as emulation, font, pitch, and color. All changes take effect immediately, without your turning the printer off. Watch out, though—if this rugged printer ends up in a multiuser environment, just one absentminded fiddler could change the settings with the press of a button. Still, the Printer Status button prints out a report of how all your options are set, and the Save option lets you store up to five settings.

Letting your fingers do the walking across the control panel brings you to the AMT's well-designed paper-parking function. Touch the paper-park button and the push-feed tractor retracts the continuous-feed paper to allow you to use the cut-sheet feeder. The Ready button reactivates the continuous feed paper and brings the paper to the top of the form. You don't have to worry about remembering to set the bail, as it is done automatically for you. Additionally, both the bail-setting and top-of-form functions are manually accessible by buttons on the control panel. And paper handling is rugged enough that multipart forms posed no problem.

The AMT Accel-500's wide carriage is good for anyone who deals with spreadsheets, and its ability to handle multipart forms is an asset. However, for the \$1,485 base price, it should be able to handle letter-quality printing as well.

## AT&T 583

by Bruce Brown

When it comes to the AT&T 583, many buyers will be drawn by the vendor name alone—but few will be attracted by its print quality, speed, features, or price. At \$1,295, the AT&T 583 is a 24-pin wide-carriage, color-capable dot matrix printer. The 583 model is the big sibling of the 580 and 581 models, both black-and-white printers in narrow- and wide-carriage versions, respectively (not reviewed here). The 583 weighs 27.6 pounds and measures 5.5 by 22.75 by 15.75 inches (HWD). Parallel and 25-pin serial interfaces are both standard, as is a nonexpandable 32K print buffer.

The 583 is up to speed in terms of emulations, including compatibility with the Epson LQ-2500, IBM Proprinter XL24, and Epson JX-80 for color printing. Courier 10 is its only resident font—fine for general business printing, but most 24-pin printers in this price range have at least three or four NLQ fonts. AT&T sells 14 font cartridges for \$75 each, so you're not truly limited, but the company's decision to include just one resident font is not a good one.

In addition to draft print mode, the 583 has both NLQ and LQ modes. Both of the 583's high-quality modes are good—certainly better than what you'll find in 9-pin printer quality; however, they don't have the stunning sharpness and clarity one sees with some significantly less-expensive 24-pin printers.

## AT&T 583 Fonts & Features

Epson LQ-1500				
	Bold	Italic	Sub-Super	Underline
10 cpi	■	■	■	■
12 cpi	■	■	■	■
Compressed	■	■	■	■
Proportional	■	■	■	■
IBM Proprinter X24				
	Bold	Italic	Sub-Super	Underline
10 cpi	■	■	■	■
12 cpi	■	■	■	■
Compressed	■	■	■	■
Proportional	■	■	■	■





286

intel®

## AT&amp;T 583



## FACT FILE

AT&T Computer Systems, One Speedwell Ave.,  
Morristown, NJ 07920; (800) 247-1212  
List Price: \$1,295

Dimensions (FWD): 5.5 x 22.75 x 15.75 in  
Weight: 27 lb

Emulations: Epson LQ 2500, Epson JX-80, IBM  
Proprinter XL  
In Short: AT&T's wide-carriage 24-pin dot matrix  
printer is only OK, and that just barely. Greatly  
overshadowed by its competition, the AT&T 583  
is too expensive for its mediocre character and  
graphics quality, moderate speed, and lack of  
resident fonts.

CIRCLE 831 ON READER SERVICE CARD

583's functions and parts.

The 583 uses 2-million-character black fabric ribbons priced at \$48 for a box of six and four-color ribbons that cost \$66 for three. The ribbons are the clam-cartridge type and are easy to install.

Both friction feed and an internal tractor for continuous form feed are standard. I found the tractor feed a bit persnickety. It was too easy to catch the first sheet of a stack of continuous paper on the paper bail, resulting in paper jams. Once past the first edge of the paper, all went well as long as the paper-feeding stack was reasonably straight. The 583 has one-button paper loading and parking that works well with the exception of the paper bail. An optional single-bin cut-sheet feeder with a 100-sheet capacity costs \$405 with a second bin addition for an extra \$255.

And for a final beef, the 583 isn't even quiet, reaching an unpleasant 78 decibels on our noise test.

In 1984 the AT&T 583 printer would have received a good deal of positive attention, ranking it with the then-hot Texas Instruments 85 and Epson LQ-1500 printers, both of which made news because they took dot matrix NLQ printing to new levels. In 1989, however, the 583 is just another 24-pin printer—albeit one that offers color—and not a terrific deal.

## Brother M-1809

by M. David Stone

Anybody can build a printer with a desirable mix of features, but Brother has the admirable habit of producing such printers at reasonable prices. Consider, for example, the M-1809, a color-capable 18-pin printer with a price of \$549 for the black-and-white version or \$627 with the color kit and ribbon added. There is nothing that stands out as special in this printer, but that's only because the features balance each other so well.

Installing the M-1809 is reasonably simple. The printer is designed around the increasingly common scheme of a built-in push tractor. To set it up, just load paper, snap in the ribbon cassette, and plug in the cable and power cord.

If you've ever used a printer before, you can probably manage the setup without the manual. If not, just a glance at the illustrations will set you straight. But if you need more information, you'll find

Brother M-1809

## Fonts & Features

### IBM Proprinter 9-pin

	Bold	Italic	Sub-Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

### Epson FX

	Bold	Italic	Sub-Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

that the manual is well written and well organized.

The M-1809 approach to changing defaults has more in common with laser printers than with other dot matrix models. A front-panel LCD shows menu options, while a set of buttons lets you move through the menus and make selections. Among other choices, the menus let you set defaults for quality (draft, NLQ, LQ), pitch (10, 12, 17, or 20 characters per inch or proportional space), and emulation (IBM Proprinter or Epson FX/JX).

The menu structure and front-panel buttons are easy enough to remember once you've used them, but they're not particularly intuitive. Fortunately, the manual does an excellent job of explaining them. Even better, Brother includes a chart of menu functions taped to the top of the printer. The chart has an adhesive backing with a peel-off protector, so you can paste it wherever it's most convenient.

Paper handling is another capability worth mentioning. Like many printers with push tractors, the M-1809 includes a paper-park feature, so you can print on single sheets and envelopes without having to remove the continuous-form paper. Another nice touch is that the lever for adjusting the printhead gap is on the outside of the printer. It's exceedingly easy to get at when you change between, say, continuous form paper and index cards. The printer handled multipart forms and heavy card stock without problems on PC Labs' tests.

On the speed tests, the M-1809's speeds ranged from 127 characters per sec-

Graphics printing is also just adequate. The 583's maximum resolution is 360 by 180 dpi, down from the straight 360 by 360 used on many 24-pin printers. The 583 passed the Epson JX-80 compatibility test using the JX-80 setting for the PC Labs graphics speed test, which took a whopping 204 seconds in JX-80 mode, 80 seconds in LQ-2500 mode, and 97 seconds in Proprinter mode. The color separation and clarity were acceptable in the JX-80 mode but not particularly dark.

The 583's text speed is satisfactory but nothing to crow about. The highest speed run we could get in draft mode was 94 characters per second. In NLQ mode, its top score was 50 cps, with 56 cps in NLQ proportional mode.

The 583's control panel uses membrane buttons and simple green LED indicators to run the printer. The same buttons serve double duty with a comprehensive menu system for changing settings and functions. The menu system takes a bit of getting used to; it isn't helped by a manual that tries hard but just doesn't make system operation any easier. Otherwise, the manual is a clearly organized document with quick reference sheets for both IBM and Epson command sets and clear illustrations of the

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## PRINTERS COLOR DOT MATRIX

and for draft-quality text to about 26 cps for highest-quality text. In every level of print quality, the Proprinter mode outdid the Epson mode—sometimes dramatically. Draft mode in particular showed a marked difference, with a measured speed of only 83 cps in Epson emulation compared with 127 cps for IBM Proprinter emulation. For highest quality, the speed differed by about an insignificant 3 cps.

The printer offers three levels of print quality: draft, so-called letter quality, and a middle range, midspeed NLQ. Draft

and filled in, patterned areas maintain detail, and the scanned photo shows as much subtle shading as you can expect from the particular emulations. In the Epson JX color output, colors are also suitably dense and generally unreddened. In Epson mode, the machine printed our scanned photo in a reasonably speedy 75 seconds.

The M-1809 measures 5.5 by 18 by 15 inches (HWD), and weighs in at about 20 pounds. That's on the hefty side for a narrow-carriage printer but small enough to fit comfortably on your desk. More important, the noise level is not intrusive, and the sound is a relatively pleasant, deep buzz.

By any measure, Brother's M-1809 is a well-designed printer. And it offers a seductive combination of high-quality output, color, and price. There are faster printers with higher-quality text and graphics, but they cost more. If you want a color printer—or at least color capability—and price is a consideration, take a look at the Brother M-1809.

## Brother M-1824L

by **M. David Stone**

At first glance, the 24-pin Brother M-1824L looks like a near twin of the same company's 18-pin M-1809. The two share essentially the same physical design, from their size to built-in rear push tractor to front-panel buttons and LCD. They even use the same ribbons and color kit. But you'll pay about \$200 more for the M-1824L, and with good reason: the *L* stands for letter quality, and indeed, the M-1824L delivers.

The M-1824L sells for \$749 for the black-and-white version—an extra \$78 buys the color kit and ribbon. True to its name, the M-1824L prints type of superb quality throughout. Draft-quality text is somewhat light but nearly fully formed and highly readable. LQ text, in all variations, is solid, crisp, and reasonably dark. Even the 17-character-per-inch high-speed draft is notable for its readability.

If not in print quality, most other aspects of the M-1809 and M-1824L are identical. Installation of the M-1824L is just as easy as with the M-1809, and the front-panel controls on the two printers match. The printers also take the same approach to setting options, but there are some differences in the menus.

For example, the M-1824L has only a

## Brother M-1824L Fonts & Features

### Epson LQ-1500

	Bold	Italic	Sub-Super	Underline
10 cpi	■	■	■	■
12 cpi	■	■	■	■
Compressed	■	■	■	■
Proportional	■	■	■	■

### IBM Proprinter X24

	Bold	Italic	Sub-Super	Underline
10 cpi	■	■	■	■
12 cpi	■	■	■	■
Compressed	■	■	■	■
Proportional	■	■	■	■

draft and LQ choice for print quality, with no midrange option. It also adds pitch choices of 15 cpi; condensed proportional spaced to 10, 12, 17, and 20 cpi; and standard proportional text. And the M-1824L has three extra built-in fonts in addition to the Prestige and Quadro choices: Gothic, Brougham, and OCR-B. As with the M-1809, the M-1824L can accept an optional font card.

Although the printers share the same construction, the M-1824L did not handle heavy card stock as well as its 18-pin twin. When printing with the push tractor, the heavy paper consistently pushed the bail from the roller, folded up under the top cover, and jammed. However, the problem disappeared when I switched to the \$129 optional external pull tractor. The push tractor handled multipart forms without difficulty.

On the text speed tests, the M-1824L managed 121 characters per second for standard draft and an impressive 61 cps for letter quality. Proportionally spaced text was a little faster at about 70 cps. For high-speed draft in IBM Proprinter 24-pin mode, the printer clocked in at 135 cps, and in Epson LQ mode, it turned in its top speed of 149 cps. The difference for high-speed draft between the two emulations is due to a difference in available pitch.

Graphics output in both emulations is on a par with text output. Black-and-white graphics are crisp, with even the smallest patterns on PC Labs' emulation tests retaining all their detail. The scanned photo, which took a respectable 75 seconds,

**BROTHER M-1809**





**FACT FILE**

Brother International Corp., 8 Corporate Pl.,  
Piscataway, NJ 08855-0159; (800) 284-2844,  
(201) 485-6969

List Price: \$627 (including \$78 color kit).

Dimensions (HWD): 5.5 x 18 x 15 in.

Weight: 20 lbs.

Emulations: Epson FX/JX, IBM Proprinter (9-pin)

In Short: A well-designed 18-pin printer, the M-1809 offers a solid combination of high-quality output, color, and a reasonable price.

■ CIRCLE 632 ON READER SERVICE CARD

quality is readable but light, with individual dots showing clearly—it's not the sort of output you'll want to read much of at one sitting. The highest-quality text is eminently readable. Individual characters are dark and solid, although the shape and thickness of the characters are a dead giveaway of their dot matrix origin.

The middle-level NLQ provides a suitable compromise for most real-world tasks. The speed is about 43 characters per second in Proprinter mode and about 37 just in Epson mode. Again, characters are dark and solid, though not as thick or as dark as in the LQ mode.

Graphics output in both emulations is good. Flat black areas are properly dark

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CIRCLE 196 ON READER SERVICE CARD

# BROTHER M-1824L



## PC FACT FILE

Brother International Corp., 8 Corporate Pl., Piscataway, NJ 08855-0159, (800) 284-2844, (201) 465-6969.

List Price: \$627 (including \$78 color kit). Dimensions (HWD): 6 x 8.25 x 15 in.

Weight: 19.8 lbs. Emulations: Diablo 630, Epson LQ, IBM Proprinter XL24.

In Short: Even better than its 18-pin twin, this 24-pin dot matrix delivers letter-quality text at an impressive speed and good graphics output with unmodulated colors at a respectable speed.

CIRCLE 633 ON READER SERVICE CARD

shows shading and definition appropriate for each emulation. The colors in the LQ-2500 test are similarly crisp, clean, and acceptably solid—with no muddiness at all.

In addition to all its other good points, the M-1824L is a pleasant desk mate, with a measured noise level of 73 decibels and a sound quality that's best described as a deep, rasping buzz. All of which means that the printer has far more going for it than against it. As much as the M-1809 is a good all-purpose printer, the M-1824L is better. And if your budget can stretch to \$749 plus \$78 for the color kit, the \$200 extra expense is well worth it.

## Citizen HSP-500 Citizen HSP-550

by Henry Ferako-Weiss

The Citizen HSP-500 and 550 prove that 9-pin printers still have life in them, and in this case color as well. These narrow- and wide-carriage models are compact, lightweight, and fast, and they even manage to produce superior output—all for just \$578 and \$798, respectively. If you aren't interested in color, take \$79 off the price for the

## PRINTERS COLOR DOT MATRIX

narrow-carriage and \$99 off the price of the wide-carriage.

You won't strain your back moving these printers around. The narrow HSP-500 weighs only 12.5 pounds, and the wide HSP-550, 17 pounds. Both printers have a very low profile—just over 4 inches high—that gives them a sleek appearance.

All of the control switches and levers are well positioned. The on/off switch is located along the left side of the printer's casing, while the parallel cable connector is located along the right side toward the front. Just under the cable connector are two sets of default switches that are fairly accessible—although it's annoying to use DIP switches to change the printer emulation and some of the other functions. Two levers—one for parking continuous paper and another to allow friction feeding of

## The compact and fast Citizen HSP-500 and 550

prove that 9-pin  
dot matrix printers still  
have plenty of life  
in them, and in this case  
color as well.

single sheets—are well placed: one on each side along the top of the printer. You never have to take out the continuous-form paper to print a letter on letterhead stationery or to print an envelope.

The tractor mechanism can be installed in two positions, which lets you push or pull the paper through the printer. In the push position you can easily tear paper off and reverse the motion of the paper to take advantage of the automatic paper park when printing on single sheets. The pull position is more reliable for long print jobs because the HSP prints more evenly when set up this way. It's unusual for printers in this price range to offer the convenience of a push/pull tractor.

A control panel on the upper-right front of the printer completes the thoughtful de-

sign. In addition to the paper-out and on-line LED lights, there are lights to indicate the various print modes. You can change from draft to NLQ, and various combinations of the two, with high-speed and proportional modes—eight in all. You can also select the two internal fonts (roman and sans serif) or an optional font card through the soft-touch buttons on the front panel.

One print function you can't control from the front panel is the emulation. The HSP emulates the Epson FX, EX, and JX printers, or the IBM Proprinter (9-pin). To change from Epson to IBM emulation, you throw one DIP switch. DIP switches also control the character sets being used, the page length, the automatic paper-feed functions, and unidirectional or bidirectional printing.

A weakness in the printer's physical design is the ribbon housing. The ribbon has to ride in a ribbon guide; if it doesn't, the tops of lines at the left side of the paper can be lopped off or sometimes nothing is printed at all. The ribbon cartridge seems to snap down rather easily and securely in the wrong position, giving you a false sense of having done it right until you start to print. Still, if you're careful, you may avoid this problem.

For 9-pin printers, these Citizen models offer good quality NLQ type—you can hardly see the character dots. In addition to pica, the printer comes with two native fonts: Roman and sans serif. You can also buy an optional font card. It costs \$60 and it offers a slightly different sans serif type-

### Citizen HSP-550

#### Fonts & Features

	Epson FX			
	Roman	Italic	Sub-Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				
	IBM Proprinter 9-pin			
	Roman	Italic	Sub-Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				



# PRINTERS COLOR DOT MATRIX

face, as well as Orator.

The HSPs were the fastest color models tested in text speeds. Under the Epson emulation, in draft mode, the 500 clocked in at 151 characters per second, and its wider sibling scored 156 cps. In NLQ, each came in at a respectable 56 cps. On our graphics speed test, these models came in with reasonably speedy scores: both produced the halftone image in 94 seconds.

Both HSPs produce very good graphics. The black or colored areas have a uniform density and a nice depth of color. Unfortunately the colors can appear to be

gray shading into a solid black—the HSP doesn't.

The HSPs are noisy, so be prepared for a shrill, high-pitched whine. On the PC Labs noise test it registered a high 82 decibels. You can print in a quiet mode, but that means printing at half-speed.

It might not be in vogue to buy a 9-pin dot matrix printer these days, especially now that 24-pin printers are coming down in price, but both HSP models offer such high-quality text and graphics that you won't give up much on this score. Add that you can have color printing and still keep the cost under \$600 for the narrow-carriage model and under \$800 for the wide-carriage, and you've got a pair of printers that might make it worth it to break the fashion code.

## C. Itoh C-610

by John R. Quain

If you've ever attempted to teach someone how to parallel park, you'll appreciate the automatic paper-handling abilities of the C-610. C. Itoh's 24-pin, narrow-carriage color printer won't make you cringe when moving paper in and out of tight spaces or force you to feed it detailed instructions to move its tractors in the right direction. At \$799, it's a real deal.

On the other hand, if you're in the market for a reasonably priced four-cylinder model to get you from A to B with simple letter-quality output, you'll find the C-610 a bit slow. There's no high-speed draft mode. At 92 characters per second on our test, its draft speed is certainly acceptable but not speedy. The sans serif output in this mode, however, is a little on the light side; reading more than a couple of pages might make you wonder if you should visit your optometrist. In letter-quality mode, at 50 cps on our tests, the type is clear but again, the letters are not quite as solid and dark as they could be.

The color model we tested produced accurate halftones, as well as clean colors. No dot matrix printer is going to render true primary colors, but this one does quite well; it's better than some others costing nearly twice as much—especially for adding panache to the odd bar graph or pie chart. There was some perceptible skewing in the lines between the color blocks on our benchmark tests, but it was minimal. Though some users may gripe that the C-

610's colors are a bit thin, the shades remain clear and distinct. Compared with the other color dot matrix printers in this roundup, the C-610's color output earned high marks.

Color output will cost you more than a few dollars; it'll also cost you some speed. The 192 seconds it took to complete our graphics test is not out of line for printers in this group, but it is nearly twice as slow as the same test completed in monochrome.

The C-610 is intended for users who need output on a variety of forms, and this is where the C-610 excels. It allows you to set up multiform stock in an optional sheet feeder, set plain continuous-form paper parked in the back, and feed single sheets through the front. Most printers these days

### CITIZEN HSP-500 CITIZEN HSP-550



### PC MAGAZINE FACT FILE

Citizen America Corp., 2401 Colorado Ave., Suite 190, Santa Monica, CA 90404, (800) 556-1234, (213) 453-0614

List Price: HSP-500, \$578 (including \$79 color kit); HSP-550, \$798 (including \$99 color kit).

Dimensions (HWD): HSP-500, 5 x 17.5 x 14.5 in.; HSP-550, 5 x 24.5 x 14.5 in.

Weight: HSP-500, 12.5 lbs.; HSP-550, 17 lbs.

Emulations: Epson EX, FX, IBM Proprinter II (9 pin)

In Short: These reasonably priced narrow- and wide-carriage 9-pin printers produce good text and graphics speedily. Minuses include noisiness and muddy colors.

CIRCLE 636 ON READER SERVICE CARD

somewhat dirty, as if brushed ever so slightly by the black part of the ribbon in passing. This can be somewhat corrected by easing back on the paper thickness lever, but if you ease back too far the black lightens up and you start to lose the depth on the colors as well. A happy medium leaves you with a little of both problems.

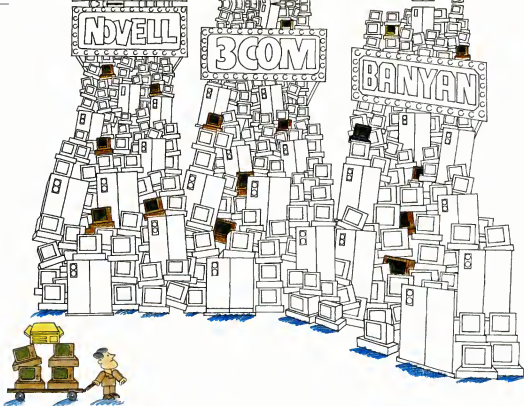
If you're using just the black ribbon, you can start to see the limits of the HSP when you print fine cross-hatch patterns: the spaces between the lines start to fill in a little. But the quality is still quite good; some printers turn what should be a deep

### C. Itoh C-610 Fonts & Features

Epson LQ-1500					
		Bold	Italic	Sub-Super	Underline
10 cpi					
12 cpi					
Compressed					
Proportional					
IBM Proprinter					
		Bold	Italic	Sub-Super	Underline
10 cpi					
12 cpi					
Compressed					
Proportional					

claim automatic paper parking and zero tear-off, but the ease with which the C-610 conducted itself here makes it a standout for those who require it to perform a variety of tasks.

Setting up the C-610 is relatively easy, and the user manual is helpful and lucid, though I'd dock it a few points for failing to include an index. The harmonica cartridge doesn't require surgeon's gloves, and paper is easy to load and align. But you will have to be careful of how you set the color ribbon, which will print only one color if set improperly. A micro switch senses the presence of the color ribbon and automatically accommodates it—after you toy with small wheel on the printhead. Otherwise, no special instructions are required to get the C-610 to deliver color in



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\*Serial version. Bus version is \$149. \*1-2-3 is a trademark of Lotus Corp.

# PRINTERS

## COLOR DOT MATRIX

### C. ITOH C-610



### PC FACT FILE EDITOR'S CHOICE

C. Itoh Electronics Co., 2505 McCabe Way, Irvine, CA 92714-6297; (800) 347-2484, (714) 860-1421.

List Price: \$799.

Dimensions (HWD): 8.25 x 18 x 19 in.

Weight: 26.5 lbs.

Emulations: Epson LQ-2550, IBM Proprinter XL.

In Short: Though its letter-quality output could stand some improvement, the C-610's color output, fine paper-handling ability, and low price make it a good choice.

CIRCLE 634 ON READER SERVICE CARD

the Epson LQ-2550 emulation.

The control panel of the C-610 has membrane keys, which may guard against sticky fingers, but I'm not a fan. Although the printer allows you to set features such as the slash zero and proportional spacing from the front panel, in order to access the LCD menu, the user must first power-off the printer and then power-up while holding down one of the keys—an inconvenience that I could do without.

At \$799, the C-610 is a bargain, and its paper-handling skills and above-par color output make this model a must to test drive.

## Epson LQ-2550

by Bruce Brown

Searching for a wide-carriage printer that does everything well? Looking for high-quality NLQ print and color? If your answer to these two questions is yes, take a close look at the Epson LQ-2550. Epson's top 24-pin dot matrix printer has undergone only minor changes since last year, picking up legal and Korean character sets

as well as accessibility to a multifont module, but this \$1,499 unit is still the good deal it was last year.

The LQ-2550 emulates only the Epson LQ series, using the standard ESC/P code set. As befits its high price, the LQ-2550 includes a good selection of resident fonts, including Epson draft, Roman, sans serif, Courier, Prestige, Script, OCR-A, and OCR-B, all available in 10 and 12 pitch (characters per inch). All but the OCR fonts come in 15 pitch, and all but the draft font in proportional mode. You can also buy Epson's \$99 multifont module to pick up Epson's two Orator fonts.

The NLQ print quality is as good as it gets with 24-pin dot matrix printers. Use a fresh ribbon, and the only thing that'll beat you is a laser or true LQ printer. The LQ-2550 automatically senses paper thickness and adjusts the printhead-to-platen distance for best results. Graphics printing is very good, with nice color separation and definition. And it's fast—at 55 seconds, it handled graphics faster than any other color or dot matrix reviewed here.

The LQ-2550's speed is decent for a 24-pin printer. In 10-pitch NLQ mode, the LQ-2550 scored 68 characters per second, 75 cps in NLQ proportional, and 105 cps in draft mode. The built-in print buffer is 8K, up to four pages of normal print depending on your word processing program. The LQ-2550 is fairly quiet, regis-

### Epson LQ-2550

## Fonts & Features

	Epson LQ-1500			
	Bold	Italic	Sub Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

tering only 68 decibels in the PC Labs noise level test largely because of sound-deadening materials in the case.

The LQ-2550 is a big, chubby printer. It weighs in at 44 pounds and measures 8.25 by 27.5 by 21 inches (HWD) without a cut-sheet feeder. Both parallel and serial printer interfaces are standard, as is an internal push tractor. A \$79 external pull tractor is available, as is a \$449 dual-bin

### EPSON LQ-2550



### PC FACT FILE

Epson America Inc., 2780 Lomita Blvd., Torrance, CA 90505; (800) 922-8911. List Price: \$1,499.

Dimensions (HWD): 8.25 x 27.5 x 21 in.

Weight: 44 lbs.

Emulations: Epson LQ

In Short: The LQ-2550 is Epson's high-end, 24-pin, wide-carriage printer. If you have a normal range of office dot matrix printing needs,

including terrific-looking near-letter-quality fonts and color, this excellent printer will do very nicely. Upgrades over last year's version include a legal character set, a Korean character set, and the capability of using an optional multifont module.

CIRCLE 636 ON READER SERVICE CARD

cut-sheet feeder that takes 60 sheets of 20-pound paper in the front bin for letterhead and 150 sheets in the rear bin for blank stationery. They may not call it SmartPark on this printer, but the LQ-2550's paper parking system works equally as well as the admirable SmartPark system on some of the other newer Epson printers.

The SelectType control panel on the LQ-2550 consists of 12 buttons, 15 lights, and a 20-character LCD menu. The menu lets you change 20 printer settings and save up to four macros. The LQ-2550 comes preset with macros for draft, letter quality, small-pitch spreadsheet printing, and graphics, but for other preferences, the macros are easily changed.

It's easy to install the clamshell-style ribbons in the LQ-2550. A black fabric ribbon rated at 23 million characters costs \$15; a 100,000-character single-strike film ribbon is \$22, and a four-color ribbon costs \$28. With the four-color ribbon you can print up to seven colors.

The LQ-2550 is a praiseworthy 24-pin office-quality dot matrix printer. If you're in the market for a 24-pin printer, start looking here first—you may find no reason to look further.

## Facit B3550C

by Catherine D. Miller

The \$1,595 Facit B3550C is an 18-pin color printer designed for offices that move a lot of data but also need to print the occasional letter. Like the Facit B2400 (reviewed in this issue), the Facit B3550C distinguishes itself with excellent type quality and an elegant configuration procedure.

Setting up this wide-carriage printer for use is fairly trouble-free. Continuous-feed paper can be loaded from the bottom or back of the printer. The Facit B3550 supports a one-inch-wide long-life black ribbon, rated for 7 million characters, and a four-color ribbon, meant to print 1.4 million characters. We performed our tests with the four-color ribbon installed. (Another version of the Facit B3550 that accepts a one-half-inch black ribbon rated for 4 million characters is available for \$1,495.)

The Soft Setup procedure is used to configure the printer for a color ribbon, paper format, emulation mode, and serial communications options. Accessed by buttons on the control panel, it works the same way as the Facit B2400's: dedicated Yes and No keys are used to select or reject configuration options. The setup portion of the B3550C control panel adds a Transparent Mode button that enables the machine to print in high-speed draft mode, as well as a Hex Trace Mode in which the B3550C types the hexadecimal code for each character printed. The addition of an

Exit button allows you to leave the configuration menu at any time.

The control panel has a pitch-control dial that enables you to override the pitch commands sent by your computer. This dial lets you set the pitch to 10, 12, 15, 16.7 cpi or proportional spacing in draft mode and to 10, 12 cpi or proportional spacing in NLQ mode. If the dial is in the default position, the printer accepts pitch commands from your PC.

Paper handling is another strong feature of the B3550. The Line Feed button doubles as the Park control, and the Form Feed button doubles as a Load control. Pressing the On/Off-Line and Line Feed/Park buttons at the same time parks fanfold paper, while pressing the On/Off-Line and Form Feed/Load buttons at the same time reloads the paper after parking. Paper parking couldn't be easier. Additionally, the tractor can be pushed or pulled to change the direction in which the paper moves.

### The Facit B3550C

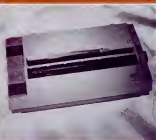
cranked out the highest  
text speeds among color  
dot matrix printers.

Optional \$175 single-bin and \$225 dual-bin sheet feeders are also available.

A lever to vary the gap between platen and printhead is located inside the cover, on the left side. The Facit B3550 handled a three-part carbon form and cardboard stock beautifully.

The Facit B3550C emulates the Epson FX/JX series and the 9-pin IBM Proprinter. It also has two additional emulations—Facit and Facit/Epson—that are carried over from the early PC printer days when the major printer manufacturers were still vying to become the standard. Printing the scanned photo in 160 seconds, it's not particularly swift for graphics. On text speed tests, however, the B3550C cranked out the highest speeds in the color dot matrix roundup: 181 cps (Epson emulation) and 181 cps (Proprinter emulation) in draft mode. In high-speed draft mode, its performance was even better, clocking

## FACIT B3550C



### PC FILE



Facit Inc., 400 Commercial St., P.O. Box 9540, Manchester, NH 03108-0540; (603) 647-2700. List Price: \$1,595.

Dimensions (HWD): 7 x 24.5 x 15.7 in.

Weight: 33.1 lbs.

Emulations: Epson FX/JX, Facit, Facit/Epson, IBM Proprinter (9-pin).

In Short: The wide-carriage Facit B3550C is a rugged 18-pin printer that does a good job with color printing and graphics. Designed for offices that need to print large quantities of data but want better type quality than that of a line printer, the Facit B3550 prints text quickly in draft mode, though not swiftly in NLQ.

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### Facit B3550C

## Fonts & Features

### Epson FX

	Bold	Italic	Sub Super	Underline
10 cpi	■	■	■	■
12 cpi	■	■	■	■
Compressed	■	■	■	■
Proportional	■	■	■	■

### IBM Proprinter 9-pin

	Bold	Italic	Sub Super	Underline
10 cpi	■	■	■	■
12 cpi	■	■	■	■
Compressed	■	■	■	■
Proportional	■	■	■	■

in at an impressive 191 cps while emulating the Epson and 192 cps in Proprinter emulation. Print quality, however, doesn't suffer at all. Speed fell off drastically in NLQ mode to surprisingly low levels: only 45 cps in both emulations.

Only Courier and Elite typefaces are built into the Facit B3550C, but it can print italic enhancements, and nine font cards are available for \$95 each. It also accepts user-defined and downloaded characters.

At 74 decibels in draft mode, the Facit B3550C is relatively quiet. For times when quiet operation is more important than speed, a low-noise button on the control panel reduces the noise level along with the printer's speed.

Like the Facit B2400, the quadrilingual (English, French, German, and Swedish) user manual for the B3550C depends on diagrams to explain procedures. A more thorough Programming Manual must be requested separately.

The Facit B3550C is a durable printer meant to handle a heavy printing load. Its great paper-handling capabilities, nice type quality, and elegant configuration procedures make it a good printer to share in a busy office.

## Fortis DQ4215

by Bruce Brown

The DQ4215 is Fortis's top-of-the-line 24-pin dot matrix printer. At a list price of \$949, the DQ4215 is a large printer obviously intended for heavy use. Equipped with the optional color kit and dual-bin cut-sheet feeder, the DQ4215 is sufficient to meet most office printing needs.

The DQ4215 is Epson LQ-2500- and IBM Proprinter-compatible. It passed the compatibility tests for graphics and character modes and was able to print the IBM high-order character set as well, missing only the single delta symbol that most other printers skip as well.

Four character fonts are built into the DQ4215—a draft font and three NLQ fonts: Courier, Gothic, and Prestige. All fonts are available in 10-, 12-, and 15-pitch (characters per inch) and as proportionally spaced fonts, as well. You can condense the 10-character-per-inch font to 17.1-cpi type for spreadsheets or any other output where you want lots of characters printed across on the same line. An optional \$79 character-font cartridge adds Script and Orator fonts.

The DQ4215 prints admirably full and clear near-letter-quality type, but it's not a speedster. In draft mode, the top speed at 10 cpi is 100 characters per second. NLQ print pumps out at 40 cps, and proportional NLQ hits just 45 cps. If you load up the DQ4215 with extra memory, the \$99 color kit, and a \$299 single-bin cut-sheet feeder, you take the list price of the printer system

past \$1,400, at which point the slower-than-100-cps performance raises at least an eyebrow.

The DQ4215 can take paper in a variety of ways. Single sheets up to 17 inches wide are fed into a slot on the bottom front of the printer. Continuous-form paper up to 16 inches wide is fed either from the rear of the printer, with the tractor unit pushing the paper, or from the bottom, with the tractor pulling the paper past the platen. This flexibility is admirable, and the tractor pulling is especially good with multipart forms, although in our tests the DQ4215 worked just fine with multipart forms pushed by the tractor from the rear of the unit. To aid in loading continuous-form paper from the rear, the printer's single-lever paper-loading and -parking mechanism works very well. Optional cut-sheet feeders include the \$299 150-sheet single bin unit and a second bin 150-sheet add-on for an additional \$229.

If you use the optional \$99 color kit, which was included in the unit we tested, you can use the four-color ribbon, which has red, yellow, blue, and black. These clam-shell ribbon cartridges cost \$18 each—less than many other vendors' color ribbons. Loading is easy, and you shouldn't even get your fingers dirty. With the color ribbon, you can print seven colors: the four ribbon colors plus purple, green, and orange, which come from mixes of the other four colors. The color sample showed clear separation of the various colors in Epson LQ2500 mode. It handled the graphics test pretty quickly, in just 1 minute and 5 seconds. The normal black fabric ribbon costs \$7.

Like Fortis's less-expensive printers, the DQ4215 has a control panel with a 16-character LCD screen, six flush buttons, and four indicator lights. You can save two sets of printer-function menu selections as Default Menu #1 and #2.

The DQ4215 requires a fair amount of surface space. At 7 by 25.75 by 16 inches, the 23-pound Fortis is movable, but you won't move it often. Parallel and 6-pin DIN serial interface ports are standard.

The standard 24K memory buffer can be increased to the maximum of 56K with the addition of a \$60 32K option. If you're going to use the DQ4215 for heavy word processing duty, the expanded memory buffer makes sense; this allows 28 pages or so of text to be held in the printer's memory until printing, giving you control of

## FORTIS DQ4215



## PC FACT FILE

Fortis Information Systems Inc., 6070 Rickenbacker Rd., Commerce, CA 90040; (213) 727-1227

List Price: \$949 (including \$99 color option).

Dimensions (HWD): 7 x 25.75 x 16 in

Weight: 23 lbs

Emulations: Epson LQ-2500, IBM Proprinter XL24

In Short: The Fortis DQ4215 is a top-of-the-line, 24-pin, wide-carriage printer compatible with a range of Epson and IBM printers. With the optional color kit, the DQ4215 is compatible with the Epson LQ2500. This relatively heavy-duty printer produces gorgeous type with three business-like letter-quality fonts.

CIRCLE 638 ON READER SERVICE CARD

your computer for other tasks that much sooner. If you use a word processing program with its own background printing facility, this feature is less important than with programs that wait until all printing is finished before returning control to you.

The Fortis DQ4215 is a full-featured, 24-pin, wide-carriage printer that has the requisite bells and whistles befitting its price and its role as head of its vendor's line. I wish it were just a bit faster.

## Fujitsu DL4400

by Bruce Brown

When the price of a dot matrix printer approaches the level of low-end lasers, it had better offer very good type as well as other inducements. The wide-carriage Fujitsu DL4400, the company's top 24-pin printer, has a combination of great print, very good graphics, very good speed, several ways to handle paper, and color-printing capability. It isn't cheap, but there's a lot to like in the DL4400.

Our test unit lists for \$1,399 with the color option. Color is not a user-installable

### Fortis DQ4215

### Fonts & Features

#### IBM Proprinter XL24

	Bold	Italic	Sub-Super	Underline
10 cpi	■	■	■	■
12 cpi	■	■	■	■
Compressed	■	■	■	■
Proportional	■	■	■	■

#### Epson LQ-1500

	Bold	Italic	Sub-Super	Underline
10 cpi	■	■	■	■
12 cpi	■	■	■	■
Compressed	■	■	■	■
Proportional	■	■	■	■





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# Fujitsu DL4400

## Fonts & Features

### IBM Proprinter X24

	Bold	Italic	Sub-Super	Underline
10 cpi	■	■	■	■
12 cpi	■	■	■	■
Compressed	■	■	■	■
Proportional	■	■	■	■

### Epson LQ-1500

	Bold	Italic	Sub-Super	Underline
10 cpi	■	■	■	■
12 cpi	■	■	■	■
Compressed	■	■	■	■
Proportional	■	■	■	■

upgrade. You can buy the same printer without color for \$1,199, but the model designation remains the same. The printer weighs a hefty 39.7 pounds and measures 9.25 by 22.5 by 18.75 inches. If you add options like sheet feeders, be sure to leave at least a couple of feet of free space above the base printer dimensions.

The DL4400 includes Epson LQ-2500 and IBM Proprinter compatibility. It is also compatible with the Fujitsu DPL24C command set, but we have no test for measuring that emulation. The DL4400 reads the codes for both 9- and 24-pin Proprinters with the same resultant fine character printing. Our graphics sample printed in Proprinter 24-pin mode was a bit shortened, while it was beautiful in Proprinter 9-pin and in both Epson modes. Color separation was terrific.

Resident fonts include draft, boldface, Correspondence, Courier, Prestige Elite, and Pica; and boldface is a proportional-space font, and the last four fonts are NLQ fonts. In draft mode, the DL4400 measured a swift 121 characters per second; in the slightly fuller Correspondence typeface, 91 cps; in NLQ, a commendable 67 cps; and in proportional NLQ, still a very good 67 cps.

The DL4400's fonts are normal business-quality standard fonts, but if you want others, Fujitsu sells seven font cartridges, all with bitmapped fonts, ranging in price from \$50 to \$145 for a six-font unit.

Standard interfaces include both Centronics parallel ports and a standard 25-pin

## PRINTERS

### COLOR DOT MATRIX

serial port, configurable up to 19,200 bits per second.

The DL4400 uses \$16 black fabric, 5-million-character ribbons for most work; \$19.95 single-strike mylar ribbons for highest print quality demands; and \$40 four-color ribbons. There are two other ribbon options—a \$55 four-color ribbon for creating transparencies and a long-life 15-million-character black fabric ribbon for \$30.

Pressure feed and an internal push tractor are standard. Paper feeds from the rear or the bottom of the machine. You can also buy an external pull tractor for \$160; a single-bin, 160-sheet capacity cut-sheet feeder, which will also hold 40 to 50 envelopes instead of paper, for \$315; and up to two more additional 100-sheet bins as add-ons for \$175 each. The widest paper the DL4400 can handle is 16.5 inches wide and rated up to 26 lbs. I had no trouble at all printing on the multipart forms or on card stock with the standard push tractor. A single load/unload button allows for a

smooth parking operation.

The Fujitsu's control panel uses a two-line 24-character LCD menu, with seven flush buttons and three LED indicators. You can control all printer settings from the control panel and save two full setting configurations in nonvolatile memory as permanent options for special tasks. These settings are permanent in the sense that they don't go away when you turn the printer off, although you can change them at any time yourself. The DL4400's standard print buffer is an ample 32K; there is no memory upgrade option.

Some people find it hard to justify spending more than \$1,000 for a dot matrix printer in these days of low-priced lasers. But a printer like the Fujitsu DL4400, which delivers good type relatively quickly with lots of versatility, isn't hard to justify. No dot matrix printer can produce laser-quality output, but if you already have a laser printer and need a general-purpose machine, the DL4400 is an interesting alternative.

## Genicom 1040


by M. David Stone

It's a rare occasion when you can take a printer out of the box, set it up with hardly a glance at the manual, and run it through the entire suite of PC Labs tests without a problem. It is rarer still for the same printer to produce letter-quality text, crisp graphics, and solid color output—all at reasonable speed and acceptable noise levels. The \$1,924 24-pin wide-carriage Genicom 1040 is just such a printer.


The 1040 is a letter-quality black-and-white printer with an optional color capability. The black-and-white version is \$1,799, and the color upgrade kit costs an additional \$125 (including the \$48.70 color ribbon). Although the color upgrade is normally installed by the user, Genicom provided the review unit with the upgrade already installed.

Setting up this printer is nearly trivial. The paper path for the built-in push tractor is unambiguous, and the tractor itself is easy to load and adjust. Installing the ribbon is a little trickier, but you can learn everything you need from a quick glance at the illustrations in the manual.

As shipped, the 1040 wakes up in Epson LQ-2500 mode and uses the printer's parallel port. If those are the settings you want, all that remains is to plug in the cable and power cord, turn on the printer, and start printing.



**FUJITSU DL4400**



**FACT FILE**

Fujitsu America Inc., 3055 Orchard Dr., San Jose, CA 95134, (408) 432-1300.  
 List Price: \$1,399  
 Dimensions (HWD): 9.25 x 22.5 x 18.75 in.  
 Weight: 39.7 lbs  
 Emulations: Epson LQ-2550, IBM Proprinter XL24, IBM Proprinter (9-pin), IBM Proprinter (24-pin)  
 In Short: The Fujitsu DL4400 is a heavy-duty 24-pin dot matrix printer. The tested unit included color printing capability, a monochrome version costs \$200 less. The character print quality is excellent, as are the graphics. The DL4400 is a speedy printer with loads of options for expansion and specific printing applications.

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**CIRCLE 340 ON READER SERVICE CARD**



If you want to change the emulation to IBM Proprinter XL24 or ANSI, or use the serial port, you have to flip some DIP switches. Even this step is reasonably minor, however. The instructions are easy to find in the manual, and the switches themselves are readily accessible from the front of the printer. The only oversight is that the switch functions aren't clearly identified in the printer itself.

Happily, the lack of labeling is confined strictly to the DIP switches. Like many printers, the Genicom 1040 includes a two-character LED with such cryptic status codes as F4 and C4. Unlike most such printers, however, the translations are

All solid areas, both in color and in black, were nicely filled in; cross-hatched areas and patterns retained all their detail, and the scanned photo retained both detail and shading.

On the PC Labs speed tests, the 1040 came in with good scores: under the Epson emulation, 114 characters per second for high-speed draft, 103 cps for draft, and 66 cps for letter-quality—an eminently readable, 12-pitch, draft-quality mode.

The Genicom 1040 offers a lot of pluses with no important minuses. It will give you color, letter-quality, and draft-quality text, sophisticated paper handling, and impact printing for multipart forms. If what you need is a single all-purpose printer, the Genicom 1040 is a good bet.

## GENICOM 1040



## FACT FILE

Genicom Corp., Genicom Dr., Waynesboro, VA 22990. (800) 535-4364, (703) 949-1000.

List Price: \$1,924 (including the \$125 color upgrade kit).

Dimensions (HWD): 8 9/16 x 22.75 x 15.75 in.

Weight: 35.4 lbs.

Emulations: ANSI, Epson LQ-2500, IBM Proprinter XL24.

In Short: Worth its price tag, the Genicom 1040 produces good color, letter-quality, and draft-quality text at a healthy clip. The unit also offers sophisticated paper handling and impact printing for multipart forms. A solid all-purpose printer.

CIRCLE 640 ON READER SERVICE CARD

## Star Micronics NX-1000 Rainbow

by Luisa Simone

The Star Micronics NX-1000 Rainbow squeezes a lot of performance out of only 9 pins. This \$379 printer delivers three near-letter-quality typefaces, color printing capabilities, and both Epson LX-800 and IBM Proprinter (9-pin) emulations.

The printer powers up in draft mode, but you can use the membrane panel located on the front of the printer to choose between Courier, Orator, and sans serif NLQ typefaces. Furthermore, the individual green LEDs clearly indicate both the typeface that is currently selected and the pitch,

## Star Micronics NX-1000 Rainbow Fonts & Features

## Epson FX

	Bold	Italic	Sub-Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

## IBM Proprinter 9-pin

	Bold	Italic	Sub-Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

Genicom 1040 Fonts & Features				
	Bold	Italic	Sub-Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				
Epson LQ				
	Bold	Italic	Sub-Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

clearly listed on the front panel. A second LED shows the current pitch (10, 12, 15, 17, or 20 character per inch) or displays "PS" for Proportional Spacing or "PC" for Proportional Condensed.

Front-panel membrane switches include the usual on-line/off-line, line feed, and form feed buttons, as well as the less-common controls for changing pitch, font, and print quality. In addition, there is a set of clearly labeled paper-handling controls. These allow you to load tractor-feed or single-sheet paper to the top of the form, to park continuous-form paper out of the way to allow for single sheets, and to momentarily advance continuous-form paper to tear off the page.

This impressive set of paper-control features is a suitable complement to the printer's paper-handling abilities. In addition to the built-in push tractor and friction

feed, you can get one of three optional sheet feeders: a single-bin model for \$440, a dual-bin model for \$735, or a dual-bin-plus-envelope-bin version for \$975. Capacities are 150 sheets per bin or 50 envelopes for the envelope bin.

Still another paper-handling option is a \$129 external tractor for the alternate, bottom-feed paper path. You may prefer this for printing on heavy paper or multipart forms, though the built-in tractor handled both of these without problems on our tests.

The only resident typeface in the 1040 is Brougham, a close cousin to Courier. The printer does have a font-card slot under the front-panel controls; as of this writing, Genicom sells one font card (not provided for review). Additional cards are promised for the near future.

As already indicated, the output quality on the Genicom 1040 is superb. On PC Labs tests, draft-quality text was easily readable and letter-quality output was unusually dark and crisp, with individual characters looking almost fully formed. Graphics output was similarly impressive.





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PRINTERS  
COLOR DOT MATRIX

which can be pica, elite, compressed, or proportional.

Although the type produced by the NX-1000 displays the rough outlines that are characteristic of 9-pin dot matrix printers, I found the various typefaces to be highly legible, individually distinct, and visually pleasing. I especially liked the Orator typeface, which you can print as either conventional upper- and lowercase characters or as a more unusual small-caps typeface.

Setting up the NX-1000 takes about 15 minutes and requires that you flip a few DIP switches. The switches control the printer's most basic configuration, such as

Any other functions that you may need in the course of operating the NX-1000 can be accessed either from the front control panel or with software codes. In fact, the ingenuity with which the four keys on the control panel are combined allows so many different functions that it gets confusing. For example, holding down the Print Pitch key and pressing the Paper Feed button automatically parks the fanfold paper. But holding down the Print Pitch and Paper Feed buttons and pressing the On-Line button will clear the printer's buffer.

Star Micronics supplies a handy crib sheet for the forgetful among us. This 6-by-8-inch card clearly diagrams the myriad functions of the control panel, including how to lock in the typeface and pitch so that a troublesome software program can't override the panel selection.

The front panel also controls the paper-parking function, which allows you to feed

**The Star Micronics NX-1000 Rainbow supplies a crib sheet, which maps out the myriad options on the front panel.**

single sheets without unloading the fanfold paper. To a large extent, this mitigates the awkward manner in which you must load fanfold paper—literally removing the back cover in order to gain access to the recessed tractor-feed mechanism. Since the whole printer weighs only 10.3 pounds, it is no surprise that the tractor feed feels a little flimsy—but even with a multipart form loader, it worked without a hitch.

Most of the time, you will simply configure your software to use the appropriate emulation mode, never giving the escape-code sequences for the NX-1000 a second thought. But the NX-1000 is forgiving of finicky older programs that can't handle either the Proprietary or Epson LX-800 emulations or that may not have color drivers. Star Micronics allows straight ASCII characters enclosed in double parentheses to be interpreted as printer commands. Just en-



EDITOR'S CHOICE

- C. Itoh C-610
- Star Micronics XB-2415 Multi Font

Color dot matrix printers, which average \$100 more than their monochrome counterparts, often represent the vendors' top-of-the-line models, with color being just one of the extra features. When picking Editor's Choice selections from among the 15 color dot matrix printers that we reviewed here, we screened first on the quality of color output, then on text speed and quality, and finally on the price. Two 24-pin color models—C. Itoh's C-610 and Star Micronics' XB-2415 Multi Font—made Editor's Choice, and two other models—Epson's LQ-2550 and Genicom's 1040—received honorable mentions.

At \$799, the narrow-carriage C. Itoh C-610 is the cheapest 24-pin color dot matrix printer in this roundup. At a tested draft speed of 92 characters per second, it's a bit slow, and its text output is average. Yet it's easy to use and offers excellent forms-handling capabilities, such as zero-forms tear-off, paper parking, and single-sheet feeding. For color output, the C-610 is a real bargain.

Another bargain is the \$1,049 wide-carriage Star Micronics XB-2415 Multi Font. In addition to producing decent color output, it has a lot of interesting fonts, plus good paper-handling capabilities. At a draft speed of 110 cps, this is the fastest of the four color dot matrix printers we admire.

Honorable mentions go to two all-purpose, higher-priced wide-carriage 24-pin printers, the \$1,499 Epson LQ-2550 and the \$1,924 Genicom 1040. The extra money won't buy you better color, but it will buy you more rugged construction, more font possibilities, extra-sophisticated paper handling, and excellent text output. Draft speeds are reasonably fast; the Epson performed at 105 cps, and the Genicom came in at 103 cps. Both are excellent machines packed with features, but they're very expensive. In this price range, wouldn't you rather have a laser?

STAR MICRONICS  
NX-1000 RAINBOW



PC  
MAGAZINE  
FACT FILE

Star Micronics America Inc., 420 Lexington Ave., #2710, New York, NY 10170; (212) 966-6770.

List Price: \$379

Dimensions (HWD): 4.5 x 15 x 12 in.

Weight: 10.3 lbs.

Emulations: Epson FX, Epson EX-800, Epson LX-800, IBM Proprietary (9-pin)

In Short: With three near-letter-quality typefaces, color capability, and basic paper-handling features, the NX-1000 Rainbow is worth serious consideration from individuals looking for an average business printer. If you don't need color, check out the older NX-1000 Multi Font, which is still available for a list price of \$299.

CIRCLE 641 ON READER SERVICE CARD

IBM Proprietary versus the Epson LX emulation. This is also the point at which you must choose either 11- or 12-inch paper length and whether or not to engage the optional-bin sheet feeder (which costs \$107, holds 50 sheets, and works like a charm). An unusual DIP-switch selection allows you to convert the printer's 4K of memory from a data buffer to a storage area for up to 192 downloadable characters. Star Micronics supplies the memory, but you must rely on third-party font manufacturers to supply the typeface.

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CIRCLE 371 ON READER SERVICE CARD



# PRINTERS COLOR DOT MATRIX

ter the string ((F))2((S))3((C))1 in a document and the subsequent text will print in Orator, double-high, double-wide, red characters.

At 67 characters per second in draft mode under the Epson emulation, the NX-1000 wasn't exceptionally fast, but the quality of the Epson emulations was excellent. I used the Epson EX-800 driver to produce the PC Labs color test image, and that worked equally well. The color version of our test graphic took almost three times as long to print as the black-and-white image.

My only real complaint about the NX-1000 Rainbow is that it essentially remains unchanged from the NX-1000 reviewed in last year's printer issue. Star Micronics has added color capability and upped the price by 80 bucks—not a great deal by my standards. However, if you can snare this printer for the going street price (up to \$150 off list), you won't be disappointed with its performance.

## Star Micronics XB-2415 Multi Font

by Luisa Simone

The Star Micronics XB-2415 Multi Font, priced at \$1,049 including color capability, operates on the premise that variety can spice up business correspondence. With the 14 resident fonts supplied (15 if you include draft), your biggest problem with this 24-pin printer may be deciding which typeface to use.

### Star Micronics XB-2415 Multi Font Fonts & Features

#### Epson LQ

	Bold	Italic	Sub Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

#### IBM Proprinter X24

	Bold	Italic	Sub Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

In addition to the standard business fonts like Times Roman, Courier, and Prestige, you'll find Cinema and Blippo, personal favorites of mine that are more funky than professional. You can also print bar codes directly, use the Greek alphabet, or choose one of the 14 international character sets to access umlauts and alternative currency symbols.

The XB-2415's high resolution of 360 dots per inch gives it the power to produce top-notch draft and near-letter-quality text and to enhance the letter forms in what Star Micronics calls super-letter-quality mode. The extra pass of the printhead produces extremely crisp, clean text for any two typefaces of your choosing.

Picking a typeface requires only that you use the font selection button on the front control panel. LEDs indicate typeface, NLQ or SLQ mode, and the pitch selection. But only seven—albeit the most frequently used seven—of the typefaces are accessible from the front panel. If you want to use one of the more unusual choices, such as bar code, for example, you must use software codes.

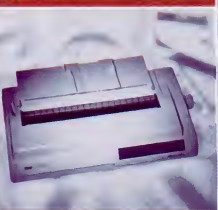
The standard escape-code sequences invoked the various typefaces and formatting features in the PC Labs test flawlessly. However, I for one would be grateful if the manual listed the decimal values instead of hex, or at least supplied a translation table for values like 0Bh.

If the typefaces that come with the XB-2415 still aren't enough for you, you can opt to use the printer's 41K buffer to download up to 128 additional characters. Star Micronics is planning to deliver even more options for the XB-2415. Although not currently available, memory upgrades of 32K and 128K are in the works, and an empty cartridge slot in the XB-2415 promises additional fonts at some point in the near future.

In some ways the XB-2415 is easier to use than its little sister, the NX-1000. It has fewer DIP switches to set and more buttons on the control panel. However, you still have to set the DIP switches to choose between the 24-pin IBM Proprinter emulation or the standard emulation, which includes graphics compatibility with NEC Pinwriter drivers and emulations for the Epson LQ-850 and LQ-1050 printers.

Having more buttons means having few functions per button. There is, for example, a separate button for paper parking, which allows you to switch between wide-

## STAR MICRONICS XB-2415 MULTI FONT



### FACT FILE

### EDITOR'S CHOICE

Star Micronics America Inc., 420 Lexington Ave., #2710, New York, NY 10170; (212) 986-6770.  
List Price: \$1,049 (including \$50 color kit).  
Dimensions (HWD): 10 x 23 x 13.25 in.  
Weight: 23.1 lbs.  
Emulations: Epson LQ, IBM Proprinter  
In Short: The XB-2415 can easily handle preprinted multipart forms, and it has enough typefaces to print a different font each day for a fortnight. With color and high-quality typefaces like Cinema and Blippo, your business correspondence will never be dull. It's even speedy.

CIRCLE 642 ON READER SERVICE CARD

carriage fanfold paper and single sheets. But all the keys still do double duty: the Paper Feed button also switches the printer into quiet mode. And if you power up the printer while holding down the On-Line, Paper Feed, and Set/Park/Eject buttons, you will enter the XB-2415's menuing system.

The XB-2415's menu deserves mention. It prints the menu out as an inverted tree, making it straightforward to navigate through the complex options. You simply position the printhead under your choice and hit Enter (On-Line). Your choices are always indicated to you with an asterisk so that you are absolutely clear about the configuration that will be stored. The printer even feeds the paper up several inches so that you can easily read the menu, and then retracts the paper after you have made your selection to avoid waste.

But features aren't everything: the XB-2415 is also fast. In draft mode it printed 110 characters per second, and using a near-letter-quality typeface yielded a very respectable rating of 52 cps. Of course, you can slow that down to less than 20 cps if you opt to print the Times Roman typeface with proportional spacing in super-let-

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## PRINTERS

### COLOR DOT MATRIX

ter-quality and also invoke the quiet mode. But that's not even a criticism—any printer that allows you to get superior output and carry on a phone conversation at the same time deserves applause. With the quiet mode engaged, the XB-2415's noise rating dropped from a standard 73 decibels to 69 dB.

Color on the XB-2415 is optional—take \$50 off the price of our tested unit for the monochrome list price. Installing the color kit is painless: just slip the attachment into a slot hidden behind the normal printhead and beneath the ribbon cartridge. I was pleasantly surprised when the color printout of the PC Labs test graphic took just 82 seconds—only 20 seconds longer than the black-and-white printout.

## The Star Micronics

### **XB-2415 offers additional**

**typefaces like Cinema**

**and Blippo—fonts**

**that are more funky**

**than professional.**

However nice color may be, the XB-2415 also deals with more-practical issues for business applications. Although I'd like to see even more paper-handling options (like an envelope feeder), the XB-2415 gets high marks for its current capabilities. You can purchase a 120-sheet bin feeder for \$249 or use the sturdy built-in tractor-feed mechanism instead.

The XB-2415 handled multipart forms easily, and it allows you to set paper length from 3 to 14 inches. Of special note is the fact that the top-of-form setting, when used in conjunction with the short-tear-off feature, allows you to print virtually the entire sheet of paper—no waste for tearing off fanfold paper. These are heaven-sent features to anyone who regularly deals with fanfold preprinted forms.

At a list price of just over \$1,000, including color capability, the feature-laden XB-2415 would be a welcome addition to any office.





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In the 6-year history of *PC Magazine's* printer project, we've tested and reviewed 592 PC printers. Today, 312 of them are still available from the manufacturers and are included in this index. For each printer, we've listed its type (daisy wheel, dot matrix, laser, or whatever), the current price, and the result from the PC Labs text speed test. To help you find everything you need to know about each printer, we've included the volume, issue, and page number of the original review.

Although we've introduced new halftone and color output tests this year, the PC Labs text speed test hasn't changed since 1984, allowing you to compare speeds across the six annual

printer issues. Note that from 1986 on, laser printer speeds have been measured in pages per minute (ppm). Dot matrix speeds have always been measured in characters per second (cps). To convert between the two measurements, remember that 4 ppm is about 267 cps. For further detail on this calculation, see the sidebar "How We Tested the Printers" in this issue.

For detailed evaluations of the 109 new printers we tested this year, see the reviews that precede this index. For quick comparisons of output and test results, see the *PC Magazine* Printer Guide that precedes each section of reviews in this issue.

Company name	Product	Type	Speed	Price	Vol.	No.	Pg.	Reader service number
<b>A</b>								
Acer	LP-76	L	5.8 ppm	\$1,995	7	18	112	
Advanced Matrix Technology	AMT Accel-500	CDM	161 cps	\$1,485	8	19	345	630
Advanced Matrix Technology	AMT Accel-500	DM	182 cps	\$1,285	7	18	234	
AEG Olympia	Laserstar 6	L	4.7 ppm	\$2,499	7	18	158	
AEG Olympia	NP30	DM	93 cps	\$299	6	19	329	
AEG Olympia	NP 80-24	DM	115 cps	\$599	8	19	246	617
AEG Olympia	NP 136-24	DM	118 cps	\$799	8	19	248	617
AEG Olympia	NPC 136-24	CDM	96 cps	\$1,049	8	19	345	643
AGFA	P3400 PS	L	10.5 ppm	\$12,500	8	19	117	396
ALPS	ASP1000	DM	47 cps	\$299	7	18	230	
ALPS	LPX800	L	5.7 ppm	\$2,175	7	18	114	
ALPS	P2100	DM	173 cps	\$1,595	5	19	224	
ALPS	P2400C	DM	170 cps	\$1,495	8	19	250	
ALPS	P2424C	DM	133 cps	\$1,495	7	18	233	
Amstrad	DMP3000	DM	59 cps	\$300	8	19	247	607
Amstrad	LQ 3500	DM	32 cps	\$500	8	19	248	608
Apple	LaserWriter IINT	L	8.4 ppm	\$4,999	7	18	118	
Apple	LaserWriter IINTX	L	6.8 ppm	\$6,999	7	18	118	
AT&T	477	CDM	144 cps	\$1,995	5	19	232	
AT&T	570	DM	124 cps	\$744	8	19	250	609
AT&T	563	CDM	94 cps	\$1,295	8	19	348	631
Axonix	LiteWrite	DM	50 cps	\$449	8	19	326	603
Axonix	ThinWrite 100	DM	60 cps	\$499	8	19	255	
<b>B</b>								
Blue Chip	M200/NLQ	DM	44 cps	\$299	8	19	253	610
Brother	HL-6e	L	7.4 ppm	\$2,895	8	19	118	397
Brother	HL-8PS	L	7.4 ppm	\$4,495	8	19	120	398
Brother	HR-20	DW	21 cps	\$549	6	19	380	

■ Editor's Choice C=color, DM=dot matrix, DW=daisy wheel, IJ=ink jet, L=laser, TT=thermal transfer.

Company name	Product	Type	Speed	Price	Vol.	No.	Pg.	Reader service number
Brother	HR-40	DW	31 cps	\$899	6	19	380	
Brother	M-1109	DM	53 cps	\$299	5	19	146	
Brother	M-1709	DM	127 cps	\$749	6	19	255	
Brother	M-1724L	DM	99 cps	\$949	7	18	238	
Brother	M-1809	CDM	83 cps	\$627	8	19	350	632
Brother	M-1824L	CDM	121 cps	\$827	8	19	352	633
Brother	M-2518	DM	123 cps	\$1,295	7	18	240	
Brother	M-4018	DM	258 cps	\$1,795	6	19	260	
Brother	Twinriter 8	DM	99 cps	\$1,395	6	19	261	
<b>C</b>								
Camlintron	TurboLaser/PS-Plus 3	L	6.5 ppm	\$5,695	8	19	123	401
Canon	BJ-130	IJ	68 cps	\$1,095	7	18	243	
Canon	LBP-8 Mark III	L	7.3 ppm	\$2,995	8	19	124	400
Citizen	GSX-140	DM	100 cps	\$499	8	19	254	611
Citizen	HSP-500	CDM	151 cps	\$578	8	19	357	635
Citizen	HSP-550	CDM	156 cps	\$798	8	19	357	635
Citizen	Tribute 124	DM	102 cps	\$599	7	18	248	
Citizen	Tribute 224	DM	91 cps	\$899	6	19	264	
C. Itoh	C-310 XP	DM	157 cps	\$739	5	19	174	
C. Itoh	C-315 XP	DM	150 cps	\$919	5	19	174	
C. Itoh	C-610	CDM	92 cps	\$799	8	19	358	634
C. Itoh	C-715A	DM	145 cps	\$1,499	6	19	267	
C. Itoh	C-815	DM	195 cps	\$2,195	6	19	268	
C. Itoh	CI-2500	DM	144 cps	\$1,049	7	18	248	
C. Itoh	CI-4000 Triprinter	DM	247 cps	\$2,195	7	18	250	
C. Itoh	LIPS II	L	9 ppm	\$3,545	7	18	147	
C. Itoh	ProWriter C-310 CXP	CDM	177 cps	\$829	6	19	270	
C. Itoh	ProWriter Jr. Plus	DM	72 cps	\$389	6	19	272	
C. Itoh	5000	DM	239 cps	\$1,995	8	19	259	612
C. Itoh	8510SP	DM	86 cps	\$649	3	23	142	
<b>D</b>								
Daisy Systems	M45Q	DM	37 cps	\$995	3	23	313	
Dataproducts	LZR 1230	L	8 ppm	\$3,695	6	19	167	
Dataproducts	LZR 1260	L	10 ppm	\$6,995	7	18	149	
Dataproducts	SI 480	IJ	288 cps	\$2,795	7	18	255	
Dataproducts	8070 Plus	DM	250 cps	\$987	7	18	261	
Dataproducts	9044	DM	102 cps	\$1,099	7	18	262	
Datasouth	DS 180	DM	128 cps	\$1,395	3	23	223	
Datasouth	DS 220	DM	150 cps	\$1,695	3	23	226	
Desktop Systems	Desktop Laser Beam	L	5.8 ppm	\$1,995	8	19	128	423
Digital Equipment Corp.	LA 210	DM	138 cps	\$1,760	3	23	213	
Digital Equipment Corp.	LNQ3	L	7.4 ppm	\$2,895	5	19	276	
<b>E</b>								
Eastman Kodak Co.	Diconix 150 Plus	IJ	70 cps	\$499	8	19	327	604
Eastman Kodak Co.	Diconix 300	IJ	96 cps	\$549	7	18	264	
Eastman Kodak Co.	Diconix 300W	IJ	96 cps	\$599	7	18	264	
Epson	DFX-3000	DM	286 cps	\$2,199	7	18	267	
Epson	EPL-6000	L	5.4 ppm	\$1,899	8	19	128	407
Epson	FX-950	DM	138 cps	\$549	7	18	267	
Epson	FX-1050	DM	141 cps	\$799	8	19	260	613
Epson	LQ-510	DM	82 cps	\$529	8	19	263	614

\*Editor's Choice, C=color, DM=dot matrix, DW=daisy wheel, IJ=ink jet, L=laser, TT=thermal transfer

Company name	Product	Type	Speed	Price	Vol.	No.	Pg.	Reader service number
Epson	• LQ-800	DM	105 cps	\$849	5	19	185	
Epson	• LQ-850	DM	153 cps	\$849	8	19	275	
Epson	LQ-950	DM	128 cps	\$949	7	18	274	
Epson	• LQ-1050	DM	163 cps	\$1,199	8	19	275	
Epson	LQ-2500	DM	104 cps	\$1,449	5	19	226	
Epson	LQ-2500	CDM	133 cps	\$1,449	8	19	278	
Epson	LQ-2550	DM	138 cps	\$1,499	7	18	276	
Epson	LQ-2550	CDM	104 cps	\$1,499	8	19	362	636
Epson	• LX-810	DM	94 cps	\$299	8	19	286	615

<b>F</b>								
Facit	B2400	DM	111 cps	\$699	8	19	266	618
Facit	B3100	DM	149 cps	\$745	6	19	284	
Facit	B3150	DM	154 cps	\$895	6	19	284	
Facit	B3350	DM	136 cps	\$995	6	19	286	
Facit	B3550C	CDM	181 cps	\$1,595	8	19	363	637
Fortis	DM 1310	DM	93 cps	\$299	8	19	288	
Fortis	DM 2210	DM	131 cps	\$499	8	19	268	620
Fortis	• DM 2215	DM	132 cps	\$599	8	19	268	620
Fortis	DP600P	L	8 ppm	\$4,499	8	19	133	406
Fortis	DP600S	L	5.8 ppm	\$1,999	8	19	133	403
Fortis	DQ 4110	DM	100 cps	\$499	8	19	270	621
Fortis	DQ 4210	DM	122 cps	\$699	8	19	273	622
Fortis	DQ4215	CDM	100 cps	\$949	8	19	364	638
Fortis	DX 41	DW	31 cps	\$799	6	19	383	
Fujitsu	DL2600	DM	170 cps	\$1,545	8	19	288	
Fujitsu	DL3400	DM	143 cps	\$925	8	19	291	
Fujitsu	DL4400	CDM	121 cps	\$1,399	8	19	364	639
Fujitsu	DL5600	DM	230 cps	\$2,195	7	18	276	
Fujitsu	DX2300	DM	129 cps	\$645	6	19	292	
Fujitsu	DX2400	DM	157 cps	\$845	6	19	292	
Fujitsu	RX7100	L	5.2 ppm	\$2,150	8	19	137	402
Fujitsu	RX7100PS	L	5.1 ppm	\$4,495	8	19	142	399
Fujitsu	RX7200	L	11.4 ppm	\$3,995	8	19	144	405
Fujitsu	RX7300E	L	14.8 ppm	\$7,950	8	19	146	404

<b>G</b>								
Genicom	Centronics Printstation 351 PC	DM	144 cps	\$1,850	4	19	164	
Genicom	1020	DM	111 cps	\$1,065	5	19	194	
Genicom	1040	CDM	103 cps	\$1,824	6	19	368	640
Genicom	3320 Quiet	DM	144 cps	\$2,395	4	19	166	
Genicom	3410XLQ	DM	150 cps	\$2,175	8	19	273	623
Genicom	3820	DM	235 cps	\$2,475	8	19	280	624
Genicom	5010	L	6.5 ppm	\$4,995	6	19	162	

<b>H</b>								
Hewlett-Packard	DeskJet	U	61 cps	\$795	7	18	279	
Hewlett-Packard	• DeskJet Plus	U	2 ppm	\$995	8	19	268	619
Hewlett-Packard	• LaserJet Series II	L	7.5 ppm	\$2,895	8	19	185	
Hewlett-Packard	• LaserJet Series IID	L	7.5 ppm	\$4,295	6	19	150	415
Hewlett-Packard	• LaserJet Series IIP	L	3.9 ppm	\$1,495	8	19	152	412
Hewlett-Packard	PainJet	U	78 cps	\$1,395	8	19	297	
Hewlett-Packard	RuggedWriter	DM	173 cps	\$1,695	7	18	280	
Hewlett-Packard	ThinkJet	U	70 cps	\$495	3	23	172	

• Editor's Choice, C=color, DM=dot matrix, DW=daisy wheel, U=ink jet, L=laser, TT=thermal transfer.



Company name	Product	Type	Speed	Price	Vol.	No.	Pg.	Reader service number
Honeywell-Bull	Bull 4/66	DM	235 cps	\$2,400	6	19	302	
Howtek	Pixelmaster	CIJ	N/A	\$8,495	8	19	216	544
Hyundai	HDP-910	DM	54 cps	\$259	8	19	282	625
Hyundai	HDP-920	DM	52 cps	\$349	8	19	282	625
Hyundai	HDP-1810	DM	87 cps	\$399	8	19	284	626
Hyundai	HDP-1820	DM	57 cps	\$519	8	19	284	626
<b>I</b>								
IBM	LaserPrinter	L	8.9 ppm	\$2,695	8	19	156	420
IBM	Proprinter II	DM	129 cps	\$549	6	19	304	
IBM	Proprinter II XL	DM	111 cps	\$649	7	18	282	
IBM	Proprinter III	DM	173 cps	\$649	7	18	285	
IBM	Proprinter III XL	DM	173 cps	\$899	7	18	285	
IBM	Proprinter XL	DM	119 cps	\$799	5	19	186	
IBM	Proprinter XL24E	DM	159 cps	\$1,199	8	19	286	627
IBM	Proprinter X24	DM	172 cps	\$799	6	19	307	
IBM	Proprinter X24E	DM	100 cps	\$999	8	19	286	627
IBM	Quickwriter	DM	192 cps	\$1,699	7	18	285	
IBM	Quietwriter Model 2	TT	28 cps	\$1,399	5	19	226	
IBM	Quietwriter III	TT	81 cps	\$1,699	6	19	312	
IBM	4216 Personal Pageprinter	L	5.6 ppm	\$4,999	7	18	150	
Infoscibe	800	DM	108 cps	\$1,795	5	19	245	
Infoscibe	1100	DM	102 cps	\$1,590	7	18	286	
Infoscibe	1400	DM	173 cps	\$1,845	7	18	290	
<b>K</b>								
Kyocera	F-1000A	L	9.4 ppm	\$2,895	7	18	152	
Kyocera	F-2010	L	6.8 ppm	\$4,895	6	19	188	
Kyocera	F-3010	L	16 ppm	\$8,395	6	19	190	
<b>L</b>								
Laser Computer	190E	DM	90 cps	\$370	8	19	288	628
Laser Computer	240	DM	147 cps	\$600	8	19	290	629
Laser Connection	Big Kiss II	L	7.5 ppm	\$4,495	8	19	192	
<b>M</b>								
Mannesmann Tally	81	DM	73 cps	\$299	8	19	298	647
Mannesmann Tally	85	DM	89 cps	\$569	5	19	164	
Mannesmann Tally	87	DM	113 cps	\$569	8	19	317	
Mannesmann Tally	90	IJ	101 cps	\$799	8	19	317	
Mannesmann Tally	222	DM	89 cps	\$999	7	18	291	
Mannesmann Tally	230/24	DM	106 cps	\$1,499	7	18	291	
Mannesmann Tally	290	DM	133 cps	\$1,199	5	19	208	
Mannesmann Tally	330	DM	190 cps	\$1,878	8	19	320	
Mannesmann Tally	340	DM	150 cps	\$2,278	7	18	292	
Mannesmann Tally	490	DM	247 cps	\$2,799	5	19	250	
Mannesmann Tally	905	L	5.1 ppm	\$1,995	8	19	158	418
Mannesmann Tally	910	L	9 ppm	\$3,695	8	19	197	
Mannesmann Tally	910 UPS	L	8.3 ppm	\$5,495	8	19	180	421
<b>N</b>								
NCR	6435	L	5.8 ppm	\$2,395	8	19	162	417
NEC	Pinwriter P90L	DM	157 cps	\$1,630	6	19	322	
NEC	Pinwriter P2200XE	DM	95 cps	\$499	8	19	296	649
NEC	Pinwriter 5200	DM	138 cps	\$799	7	18	296	

\*Editor's Choice, C=color, DM=dot matrix, DW=daisy wheel, IJ=ink jet, L=laser, TT=thermal transfer, N/A=not applicable. PC Labs test speed tests could not be run because the printer prints to disk and external software handles the actual printing.

Company name	Product	Type	Speed	Price	Vol.	No.	Pg.	Reader service number
NEC	• Silentwriter LC 890	L	8 ppm	\$4,995	6	19	200	
NEC	Silentwriter LC 890XL	L	7.4 ppm	\$6,995	8	19	164	411
<b>O</b>								
Office Automation Systems	LaserPro Express Series II	L	7.4 ppm	\$2,495	6	19	205	
Office Automation Systems	LaserPro Gold Express	L	7.2 ppm	\$3,995	7	18	154	
Office Automation Systems	LaserPro Silver Express	L	7.4 ppm	\$2,995	6	19	208	
Office Automation Systems	LaserPro 610R	L	7.5 ppm	\$3,995	5	19	292	
Office Automation Systems	LaserPro 1510R	L	13.5 ppm	\$6,495	7	18	156	
Okidata	• Laserline 6	L	5.8 ppm	\$2,145	8	19	213	
Okidata	Microline 172	DM	83 cps	\$289	8	19	299	648
Okidata	Microline 182 (IBM)	DM	80 cps	\$319	5	8	149	
Okidata	Microline 182 (Standard)	DM	80 cps	\$319	5	6	151	
Okidata	Microline 182 Turbo (IBM)	DM	94 cps	\$339	6	19	300	650
Okidata	Microline 293 (Standard & IBM)	CDM	123 cps	\$839	5	19	174	
Okidata	• Microline 320	DM	164 cps	\$499	7	18	300	
Okidata	• Microline 321	DM	157 cps	\$699	7	18	300	
Okidata	Microline 390	DM	144 cps	\$699	7	18	300	
Okidata	Microline 391	DM	136 cps	\$949	7	18	300	
Okidata	Microline 393	DM	170 cps	\$1,499	6	19	326	
Okidata	Microline 393C	CDM	163 cps	\$1,599	7	18	302	
Okidata	• Okimate 20	CTT	26 cps	\$288	4	19	97	
Okidata	• Pacemark 2410	DM	216 cps	\$2,495	4	19	168	
Olivetti	DM280	DM	82 cps	\$595	5	19	172	
Olivetti	DY450	DW	43 cps	\$1,499	5	19	340	
Olivetti	DY800	DW	55 cps	\$1,899	5	19	344	
Output Technology Corp.	560DL	DM	147 cps	\$1,995	8	19	301	651
Output Technology Corp.	TriMatrix 850XL	DM	307 cps	\$2,495	8	19	330	
<b>P</b>								
Panasonic	KX-P1090i	DM	90 cps	\$300	6	19	332	
Panasonic	• KX-P1091i	DM	99 cps	\$300	6	19	336	
Panasonic	KX-P1092i	DM	113 cps	\$530	6	19	336	
Panasonic	• KX-P1124	DM	87 cps	\$530	8	19	302	657
Panasonic	• KX-P1180	DM	59 cps	\$300	6	19	303	658
Panasonic	KX-P1191	DM	35 cps	\$400	6	19	306	659
Panasonic	KX-P1524	DM	118 cps	\$949	8	19	339	
Panasonic	KX-P1592	DM	121 cps	\$680	6	19	342	
Panasonic	KX-P1595	DM	138 cps	\$770	5	19	201	
Panasonic	KX-P3131	DW	17 cps	\$500	6	19	384	
Panasonic	Laser Partner	L	10.1 ppm	\$2,595	7	18	161	
Personal Computer Products	LaserImage 2000	L	7.5 ppm	\$3,495	6	19	214	
Personal Computer Products	LaserImage 3000	L	7.3 ppm	\$6,395	6	19	216	
Primages	Primage 90GT	DW	56 cps	\$1,295	6	19	386	
Printek	FormsPro 2000	DM	111 cps	\$2,095	5	19	247	
Printek	910 HT	DM	144 cps	\$1,325	3	23	214	
Printek	920 HT	DM	203 cps	\$1,895	3	23	288	
Printek	930	DM	111 cps	\$1,995	3	23	215	
Printnrix	L1012	L	9.9 ppm	\$8,495	6	19	218	
Printnrix	L2324 Report Expediter	L	20.9 ppm	\$15,500	8	19	167	419
Printnrix	P1013 Personal Line Printer	DM	99 cps	\$895	5	19	182	
Printnrix	S-7024	DM	151 cps	\$1,365	6	19	394	
Printware	720 IQ Laser Imager with 1200 HD Image Processor	L	6.7 ppm	\$12,980	6	19	221	

• Editor's Choice, C=color, DM=dot matrix, DW=daisy wheel, U=ink jet, L=laser, TT=thermal transfer.

Company name	Product	Type	Speed	Price	Vol.	No.	Pg.	Reader service number
<b>Q</b>								
QMS	ColorScript 100 Model 10	CTT	2.8 ppm	\$9,995	8	19	217	545
QMS	ColorScript 100 Model 30	CTT	2.2 ppm	\$15,995	8	19	218	546
QMS	Kiss Plus 30	L	7.5 ppm	\$3,920	7	18	163	
QMS	Lasergrafix 800	L	115 cps	\$6,495	4	19	180	
QMS	PS-810	L	6.7 ppm	\$4,495	7	18	185	
QMS	PS-820	L	6.9 ppm	\$6,495	8	19	172	410
QMS	PS-1500	L	8.6 ppm	\$7,995	8	19	174	409
QMS	PS-2200 Model S	L	13.5 ppm	\$12,995	8	19	178	413
Quadram	Quadlaser I	L	7.5 ppm	\$3,495	6	19	226	
Qume	CrystalPrint Publisher	L	5.1 ppm	\$4,499	8	19	176	414
Qume	CrystalPrint Series II	L	5.8 ppm	\$1,999	7	18	167	
Qume	CrystalPrint WP	L	5.8 ppm	\$1,395	7	18	173	
Qume	LaserTENplus	L	8.8 ppm	\$2,795	6	19	229	
Qume	ScriptEN	L	8.2 ppm	\$4,495	7	18	174	
Qume	Sprint 11/55 Plus	DW	54 cps	\$1,295	3	23	340	
Qume	Sprint 11/90 Plus	DW	63 cps	\$1,495	4	19	172	
Qume	Sprint 11 Plus Widetrack	DW	38 cps	\$1,895	4	19	174	
<b>R</b>								
Raster Devices Direct	Impression	L	4.1 ppm	\$2,495	8	19	179	422
Relisys	RP1814	DM	99 cps	\$225	7	18	305	
Relisys	RP2410	DM	93 cps	\$259	7	18	306	
Relisys	VP1821	DM	91 cps	\$599	7	18	306	
Ricoh	PC Laser 6000	L	8 ppm	\$2,495	6	19	230	
Ricoh	PC Laser 6000/PS	L	5.3 ppm	\$4,495	8	19	181	424
<b>S</b>								
Sanyo	PR-241	DM	111 cps	\$899	6	19	346	
Seiko	CH-5504-PS	CTT	N/A	\$6,245	8	19	222	429
Seiko	DPU-40	TT	14 cps	\$125	3	23	155	
Seikosha	BP-5420AI	DM	218 cps	\$1,849	5	19	238	
Seikosha	BP-5460	DM	238 cps	\$1,999	8	19	307	660
Seikosha	SBP-10AI	DM	314 cps	\$4,495	7	18	309	
Seikosha	SK-3000AI	DM	172 cps	\$649	6	19	349	
Seikosha	SK-3005AI	DM	170 cps	\$849	8	19	349	
Seikosha	SL-80AI	DM	60 cps	\$549	6	19	354	
Seikosha	SL-130AI	DM	93 cps	\$999	7	18	311	
Seikosha	SL-230AI	DM	77 cps	\$1,999	8	19	307	661
Seikosha	SP-1000	DM	51 cps	\$299	5	19	151	
Seikosha	SP-1200AI	DM	91 cps	\$319	8	19	356	
Seikosha	SP-1600AI	DM	79 cps	\$329	8	19	308	656
Sharp	JX-9300	L	6.1 ppm	\$2,195	7	18	177	
Siemens Information	Ink Jet PT 90-12	IJ	136 cps	\$1,500	8	19	309	655
Siemens Information	PT 88S-32	DM	97 cps	\$718	8	19	312	654
Speer Technology	Desktop Laser Printer	L	5.2 ppm	\$1,495	8	19	184	419
Star Micronics	LaserPrinter 8	L	7.4 ppm	\$2,799	7	18	176	
Star Micronics	NB-15	DM	164 cps	\$1,399	5	19	222	
Star Micronics	NB 24-10	DM	91 cps	\$749	7	18	315	
Star Micronics	NB 24-15	DM	125 cps	\$999	8	19	358	
Star Micronics	NR-10	DM	108 cps	\$529	7	18	315	
Star Micronics	NR-15	DM	151 cps	\$799	6	19	361	
Star Micronics	NX-15	DM	84 cps	\$529	6	19	367	

■ Editor's Choice, C=color, DM=dot matrix, DW=daisy wheel, IJ=ink jet, L=laser, TT=thermal transfer, N/A=not applicable; PC Labs test speed tests could not be run because the printer prints to disk and external software handles the actual printing.

Company name	Product	Type	Speed	Price	Vol.	No.	Pg.	Reader service number
Star Micronics	NX-1000	DM	71 cps	\$299	7	18	318	
Star Micronics	NX-1000 Rainbow	CDM	87 cps	\$379	8	19	370	641
Star Micronics	NX-2400	DM	64 cps	\$529	7	18	318	
Star Micronics	XB-2410 Multi Font	DM	117 cps	\$749	8	19	313	652
Star Micronics	XB-2415 Multi Font	CDM	110 cps	\$1,049	8	19	372	642
Star Micronics	XR-1500 Multi Font	DM	127 cps	\$799	8	19	313	653

<b>T</b>								
Talaris	1590-T Printstation	L	11 ppm	\$11,490	8	19	187	408
Tandy	DMP 106	DM	41 cps	\$220	7	18	321	
Tandy	DMP 107	DM	48 cps	\$280	8	19	314	663
Tandy	DMP 133	DM	87 cps	\$380	8	19	318	664
Tandy	DMP 300	DM	132 cps	\$649	8	19	318	665
Tandy	DMP 440	DM	150 cps	\$699	7	18	323	
Tandy	DMP 442	DM	160 cps	\$699	8	19	317	662
Tandy	DMP 2102	DM	136 cps	\$999	8	19	318	666
Tandy	DMP 2120	DM	138 cps	\$1,599	7	18	325	
Tandy	LP 1000	L	5.9 ppm	\$2,599	7	18	181	
Taxan	Crystal Jet	L	4.6 ppm	\$3,495	7	18	185	
Tektronix	Phaser CP	CTT	1.2 ppm	\$12,995	8	19	225	547
Tektronix	4696	CJ	26 cps	\$1,795	6	19	367	
Texas Instruments	855	DM	102 cps	\$739	3	23	195	
Texas Instruments	855 Demand Document Printer	DM	195 cps	\$2,295	6	19	365	
Texas Instruments	865	DM	96 cps	\$999	5	19	208	
Texas Instruments	875	DM	105 cps	\$799	7	18	329	
Texas Instruments	877	DM	113 cps	\$999	7	18	329	
Texas Instruments	880 AT	DM	172 cps	\$2,195	5	19	252	
Texas Instruments	OmniLaser 2015	L	7.1 ppm	\$5,995	5	19	296	
Texas Instruments	OmniLaser 2106	L	5.5 ppm	\$4,595	7	18	186	
Texas Instruments	OmniLaser 2108	L	7.4 ppm	\$5,995	6	19	232	
Texas Instruments	OmniLaser 2115	L	9.5 ppm	\$7,995	6	19	234	
Toshiba	ExpressWriter 301	DM	18 cps	\$489	8	19	328	605
Toshiba	ExpressWriter 311	DM	73 cps	\$589	8	19	332	606
Toshiba	PageLaser12	L	11.4 ppm	\$3,799	7	18	190	
Toshiba	P321SL	DM	120 cps	\$799	8	19	370	
Toshiba	P321SLC	CDM	102 cps	\$949	7	18	331	
Toshiba	P341SL	DM	125 cps	\$1,049	8	19	370	
Toshiba	P351SX	DM	150 cps	\$1,599	7	18	333	

<b>U</b>								
Unisys	AP 1324	DM	117 cps	\$1,850	8	19	319	667
Unisys	AP 1327	DM	124 cps	\$450	8	19	320	668
Unisys	AP 9206	L	5.8 ppm	\$2,995	8	19	188	426
Unisys	AP 9215-1	L	13.4 ppm	\$6,285	8	19	190	427
Unisys	AP 9230	L	21.5 ppm	\$19,500	8	19	195	425
Unisys	AP 9415	L	9 ppm	\$7,495	8	19	197	428

<b>V, X</b>								
Varityper	VT600	L	5.8 ppm	\$18,995	6	19	237	
Varityper	VT600P	L	7.9 ppm	\$18,995	8	19	187	542
Xerox	4045 Laser CP	L	9.2 ppm	\$4,995	5	19	294	

\*Editor's Choice, C=color, DM=dot matrix, DW=daisy wheel, U=ink jet, L=laser, TT=thermal transfer.

You could buy a new

**DELL<sup>SYSTEM</sup> 210** with

512K of RAM

20 Mbyte Hard Drive

12.5 MHz Processor Speed

**\$1699<sup>00</sup>**



**OR Northgate's<sup>TM</sup> New 212**



# Microstation™ with...

How can Northgate afford to offer a 286/12 with 32MB hard drive and one full megabyte of RAM when Dell's newest Series 210 system, for the same money doesn't match up?

Maybe it's the high cost of color advertising. We use two colors and pass the savings on to our customers. Would you rather get more computer for the money...or be entertained with color pictures?

**Here's a fresh idea...** Make Northgate and Dell's money-back guarantee program meaningful: Order from both companies.

**30 days later send back the loser.** Or keep life simple and place your order with Northgate. Odds are it's the one you'll keep anyway.



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**BUYER'S BEWARE!** Northgate charges credit card sales only when system is in the shipping process. Others can pay money by charging cards and never will be returned you for years of this when you receive the system.

PS. Ask about OmniKeyPLUS the new Northgate Keyboard designed the way you want!

1 Full Megabyte RAM

**100% GREATER!**

32 Mbyte Hard Drive

**50% LARGER!**

12 MHz Processor Speed

**\$1699<sup>00</sup>**

## BUYER'S SCORE SHEET.

Read the Specs. Check the Leader.  
Total the winning checks and make your decision.

Standard Features	DELL		NORTHGATE	
Processor	12.5 MHz 80286	<input checked="" type="checkbox"/>	12 MHz 80286	<input type="checkbox"/>
Memory	512K	<input type="checkbox"/>	One Megabyte	<input checked="" type="checkbox"/>
Video Interface	16 Bit Built-In (Factory Fixable) Only	<input type="checkbox"/>	16 Bit Add-on (On-Site Fixable)	<input checked="" type="checkbox"/>
Display	12" VGA Mono 31 DP	<input type="checkbox"/>	12" VGA Mono 31 DP	<input type="checkbox"/>
Floppy Drive	One - 1.2 or 1.44	<input type="checkbox"/>	One - 1.2 or 1.44	<input type="checkbox"/>
Std. Hard Drive Capacity	20 Mbyte	<input type="checkbox"/>	32 Mbyte RLL	<input checked="" type="checkbox"/>
Hard Drive Type	IDE Built-In	<input type="checkbox"/>	Can use - RLL, MFM, IDE, ESDI	<input checked="" type="checkbox"/>
I/O Capabilities	2 Ser. 1 PP	<input type="checkbox"/>	2 Ser. 1 PP	<input type="checkbox"/>
Keyboard Software	Mushy Touch 101 Diagnostic	<input type="checkbox"/>	Famous OmniKey102 On-Line Help, MS-DOS	<input checked="" type="checkbox"/>
Space Saver Case	15" W. 15" L. 4" H.	<input type="checkbox"/>	16.5" W. 16.5" L. 5.5" H.	<input type="checkbox"/>
Moneyback Period	30 Days	<input type="checkbox"/>	30 Days	<input type="checkbox"/>
Warranty	1 Yr. Parts & Labor	<input type="checkbox"/>	1 Yr. Parts & Labor	<input type="checkbox"/>
Phone Tech Support	Unlimited Toll Free	<input type="checkbox"/>	Unlimited Toll Free	<input type="checkbox"/>
Hours Open - Sales	Standard Daytime, Eve	<input type="checkbox"/>	24 Hrs. All Day Every Day - Effective 9/1/89	<input checked="" type="checkbox"/>
Hours Open - Tech	Standard Daytime	<input type="checkbox"/>	24 Hrs. All Day Every Day - Effective 9/1/89	<input checked="" type="checkbox"/>
Total	\$1,699	<input type="checkbox"/>	\$1,699	<input checked="" type="checkbox"/>
SCORE	DELL	<input type="checkbox"/>	NORTHGATE	<input checked="" type="checkbox"/>

And the winner is...

**Call NOW!**

# If these expert opinions are not enough...

Now you get the industry's top performance 386 systems at **new industry low prices.**

Desktop or Upright case... Northgate will custom build your 386 Elegance to your requirements.

**Special Note:** When you call, ask about the all-new OmniKey/PLUS keyboard. It's typing perfection.



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## Infoworld:

"Northgate's 25MHz 386 Tops the Field"

OR...

**PC Magazine** Editor's Choice  
BOTH 20 and 25MHz models.

## B-U-L-L-E-T-I-N

Northgate now shipping  
Elegance 33MHz full  
system priced at...

**\$459900**

*Elegance.*

"We hear you!" **N**

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NCS 386/20

NCS 386/25



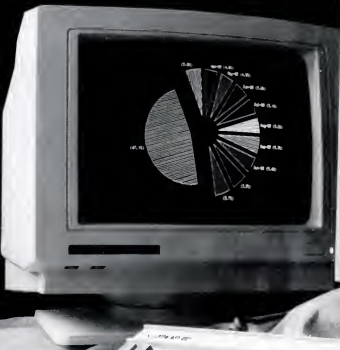
Complete  
System Pricing:  
Wide choice of hard  
drive options VGA  
to 1024 x 768, SCSI  
controller and device,  
tape backups, Modems.

**\$2999<sup>00</sup>****\$3499<sup>00</sup>**

Northgate OS/2  
Now Available  
with Systems Only  
Unit compatibility  
is guaranteed.

Both systems come with a 64K read/write-back cache as standard and can be expanded to 256K of static RAM to provide the greatest capacity cache in history. The result is systems capable of maximizing hit rate and yielding the nearest possible performance to true "zero wait".

Standard Elegance Systems come with One Mbyte of RAM; 65 Mbyte RLL 28Ms Hard Drive; Mono Monitor with Hercules Compatible card; Desktop Case; Proprietary Northgate Motherboard with eight expansion slots and 16 Mbytes of RAM capacity; MS-DOS 3.3 or 4.0; our exclusive on-line Hypertext Help program; and now the spectacular OmniKey/PLUS keyboard that's getting rave reviews everywhere.





Hot  
386/20 MHz  
System

Scorching  
386/20 MHz  
Price

**\$2599<sup>00</sup>**

COMPLETE SYSTEM: 20MHz Processor; 65MB Hard Drive; 800,000 KBS Data Transfer; 1MB RAM (Expandable to 16MB); 1.2 and 1.44 high density floppy drives; 14" Monitor; Herc. Compat. Card; MS-DOS 4.01; Full Size Desktop Case with 5 drive bays; OmniKey Keyboard; 1-Year parts/labor warranty; Replacement parts express overnight at our expense or At-Your-Office next day onsite service, one year at no extra cost. **THE BEST TECH PHONE SUPPORT IN THE COMPUTER BUSINESS.** Toll free, unlimited.

NOTE: Pipeline Page Mode system architecture is preferred in many applications to cache design. It is faster than all but the largest cache systems in certain applications requiring substantial memory calls.

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When you want to know  
all about a computer  
system ... Ask  
**Dr. Jerry Pournelle.\***

Put a machine in Pournelle's workshop. He'll soon tell you everything you want to know about it with no punches pulled.

Recently, Dr. Pournelle looked at Northgate's 80386 Pipeline Page Mode system and reported in *BYTE* July, 1989 (excerpted):

\*Jerry Pournelle holds a doctorate in psychology and is a science fiction writer who also earns a comfortable living writing about computers present and future.



"... the case is sturdy, and the motherboard construction is clean and neat. The boards are thick; I've seen some clones with boards so thin they wave in the breeze."

"... I like this machine a lot."

"... The workmanship is superior."

"... there sure wasn't any installation required for this system. I just turned it on, and it came up in MS-DOS 4.01."

[a software program] ... "which is all graphics is almost twice as fast on the Northgate 80386 as on my other machines. So is Windows ..."

"... I rate the Northgate 80386 as better than good enough on CPU and disk speed and wow! on video speed."

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"... I have reports from other people who have Northgate computers, and they're happy."

"... All in all, the Northgate 80386 looks like one of the best deals in town."

***Sudden Service: We Ship All Orders for 386/20 Systems within 4 days! \*\****



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Announcing...

NEW...

# Northgate<sup>TM</sup> OmniKey PLUS<sup>TM</sup>

*The keyboard you asked us to design!*

Thousands of you asked us to make a keyboard designed the way you want, not what IBM and all their keyboard clones force on you.

Now ... discover OmniKey PLUS!

As are all our keyboards, Northgate's engineers designed this gem from the ground up. It's not a PacRim economy job anyone can buy. IT'S EXCLUSIVELY NORTHGATE.

One look, one touch tells you this is the best in keyboard design. In quality, in all its many features so you can type faster, confident all the keys are where you want them.

**Now! Two separate keypads.** Cursor arrows in logical, comfortable array—gone is the ill-conceived "inverted T." And the backslash key is placed "just right." See detail panels.

Will you prefer OmniKey PLUS enough to discard your current keyboard? Take ten days to make up your mind. If not, return for full product cost refund.

Quantities may be limited so call or send your order today.



**F KEYS ON THE LEFT...**  
12 easy to reach, programmable F Keys where they belong and where your fingers expect to find them instinctively.

**CONVENIENCE CLUSTER...**  
Large Backspace Key; hard to miss; L shaped Enter Key; Backslash next to Shift; Unshifted Asterisk Key—a wonderful addition.

**LOOK! Just a few new**

- Alps Click/Tactile Key Switches
- Dip Switch compatible with nearly any IBM PC type system—PS/2, Zenith, Compaq, Dell, Tandy, AT&T
- OmniKey PLUS weighs 5.5 lbs., made to stay put on your desk
- Cable plugs into back of keyboard
- Low Profile Elegant Styling!

Introductory Limited Time Price

# \$119<sup>00</sup>

PATENTS PENDING

For Dealer and Distributor Program Pricing, Phone Keyboard Dept. at 612-553-0734.



**CURSOR/SCREEN KEYPAD ...**  
With arrows in familiar diamond pattern. No need to hit Num Lock or hold down Shift Key. And we "nuked" the inverted T.

**NUMERIC KEYPAD ...**  
With all the math operands in place around the numbers. Large INS, DEL and ENTER Keys. Has lit indicators above pad.

## features of OmniKey PLUS.

Phone Toll Free

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HOURS: Mon-Fri 7am-8pm. Sat. 8am-4pm Central



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Compatible with  
virtually every  
IBM type  
computer in  
the world!

Ten-day trial  
return for  
unquestioned  
full refund

Three-year  
unconditional  
warranty,  
any cause,  
we will repair  
or replace.

### New OmniKey/102 Model Also Available ... \$99.00

For those who prefer Northgate's  
OmniKey/102, an up-dated version  
now joins our line. Same trial offer,  
same 3-year warranty.



Yes, ship my OmniKey order(s).  
I understand I may use it for  
10 days and if I wish, may return  
it for full product cost refund.  
I agree to pay for freight  
both ways.

Northgate will accept COD  
and purchase orders from  
credit-worthy buyers for quantities  
totalling \$500.00 or  
greater. Dealer and distributors:  
for quantity prices phone our  
corporate headquarters  
612-553-0734.

FAX orders to 612-553-1695.

**SHIPPING:** Allow 5 days for  
order processing before ship-  
ment. Thereafter, shipments  
can be:

- UPS Ground add \$7.00 ea.  
allow 2-3 weeks for delivery.
- Overnight Air add \$25.00 ea.
- Second Day Air add \$12.00 ea.

**Northgate Computer Systems Inc.**  
13705 First Avenue North, Plymouth, Minnesota 55441

Name \_\_\_\_\_  
Company \_\_\_\_\_  
Ship to (address) \_\_\_\_\_  
City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_  
Phone \_\_\_\_\_

Computer brand & type \_\_\_\_\_

Qty.	Item	Shipping	Total
	OmniKey PLUS*	\$129.00	
	OmniKey 102	\$ 99.00	
	CT 101	\$ 99.00	
TOTAL OF ORDER*		\$	

\*Qty must specify which cable you require—for additional cables, add \$15.00 ea.

**Compatibility Notes:** Please read before placing your order.  
OmniKey PLUS is made compatible through a combination of dip  
switch settings and the proper connecting cable. We need know the  
computer make and model you will be using with  
OmniKey PLUS. Otherwise we cannot guarantee compatibility.

Brand \_\_\_\_\_ Model (AS#) \_\_\_\_\_

Prepaid amount enclosed \$ \_\_\_\_\_

Please charge to my ☐ Visa ☐ MasterCard

Card No. \_\_\_\_\_ Expires \_\_\_\_\_

Signature of Cardholder \_\_\_\_\_

My signature authorizes a charge to my account for the above merchandise prior  
to shipping to initiate processing of my order. PCMH11489

# Now Northgate gives you Credit and No Payments Until 1990\*\*

(Payments begin 90 days from the date your Northgate Computer System is delivered to you.)

Payments as low  
as \$40/month\*



2753 0915 213808

JOHN J DOE

## WHY TIE UP YOUR OTHER CREDIT CARDS?

Use the Northgate, "Big N" credit card, and avoid the "payment crunch."

Simply fill out the "Big N" application, and send it in. Prompt approval assured!

Once you're approved, simply call our TOLL FREE number and one of our expert system consultants can help you design the Northgate System which will best suit your needs, and it will be shipped to you right away.

Best of all, there will be no payments due on your Northgate System for a full 90 days starting from the day you take delivery!

Northgate also offers flexible long term leasing plans too. You can choose the plan that will best fit your needs, with terms up to 5 years.

Phone Northgate Now!...

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### BIG N REQUEST FOR CREDIT

#### INSTRUCTIONS TO RESPONDING APPLICANTS:

You must declare your marital status:  
☐ Married  
☐ Unmarried  
☐ Legally separated

A married person may apply for individual credit. I am applying for (please check appropriate box):

- ☐ **JOINT CREDIT** with another person. Complete entire application.  
☐ **INDIVIDUAL CREDIT** but rely on income or assets of another person as a basis for repaying the credit requested. Complete entire application.  
☐ **INDIVIDUAL CREDIT**. Complete sections "a" and "b" only.

Please complete all appropriate sections, providing at least two year's residence and employment history. This will enable your application to be processed as quickly as possible. If you are self-employed, please be sure to complete section "d" on back.

#### a. Your Personal Information

Your Name: First _____ Initial _____ Last _____		Date of Birth: _____		Social Security Number: _____	
Present Address: Street _____ Apt. # _____ City _____ State _____ Zip _____		Home Phone: _____			
Date of Residence: Month _____ Year _____		Monthly Payment: \$ _____		Buy Rent Other <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
Previous Address: _____		Date of Residence: _____		From _____ To _____	
Your Employer: (If self-employed, see next panel) _____		Date of Employment: _____		Position: _____	
Employer's Address: Street _____ City _____ State _____		Business Phone: _____		Monthly Income: Gross \$ _____ Net \$ _____	
Previous Employer: _____		Date of Employment: _____		From _____ To _____	
Other Income: _____		Monthly Income: Gross \$ _____ Net \$ _____		Spouse's Name and Address of Nearest Relative Not Living With You: _____	

#### b. Credit Information

Bank Account: _____		Bank Name: _____		Address: _____		<input type="checkbox"/> Checking <input type="checkbox"/> Savings <input type="checkbox"/> Checking <input type="checkbox"/> Savings	
Bank Account: _____		Bank Name: _____		Address: _____		<input type="checkbox"/> Checking <input type="checkbox"/> Savings <input type="checkbox"/> Checking <input type="checkbox"/> Savings	
Bank Loan Reference: _____		Payment: _____		Balance: _____			
Bank Card Reference: _____		Has: _____		Returned: _____			
Other Credit Reference: _____		Account No: _____		Expires: _____			
Other Credit Reference: _____		Account No: _____		Expires: _____			

#### c. Joint Applicant's Personal Information

Joint Applicant's Name: First _____ Initial _____ Last _____		Date of Birth: _____		Social Security Number: _____	
Address: Street _____ Apt. # _____ City _____ State _____ Zip _____		Home Phone: _____			
Employer: _____		Date of Employment: _____		Position: _____	
Employer's Address: Street _____ City _____ State _____		Business Phone: _____		Monthly Income: Gross \$ _____ Net \$ _____	

#### d. Self-Employed Information

Business Name: _____		Complete this section only if you are self-employed	
Business Address: _____		Partnership Corporation Partnership	
Description of Business: _____		Business Telephone: _____	
Your annual income from business: _____		Business Since: _____	
Your annual income from business: _____		Business annual income: _____	
We must provide at least one of the following:			
1. Name: _____		Telephone: _____	
2. Accountant's Name: _____		Personal Banker's Name: _____	
3. Financial statement on business attached.		Telephone: _____	

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by  
Pete Maclean

# Utilities

You can develop a Polaroid snapshot in seconds, digitize it with the hand scanner attached to your laptop PC, and autograph it "Greetings from Waikiki" with any paint program. But can you send it to the office over MCI Mail<sup>SM</sup>?

Anyone with a modem can get on MCI; it's the nearest thing there is to a universal e-mail service. The problem is getting it to deliver anything but pure ASCII text files. MCI's 7-bit barrier strips the high (8th) bit of every byte, with disastrous results if you try to send a binary-file spreadsheet, graphics or .COM file, or other binary file.

MCI does let you transmit binary files as attachments to ASCII messages, however. But to date, only one special interface program—*Lotus Express (Desktop Express for the Mac)*—lets you recover these binary attachments intact. In this issue we present an alternative to *Express*: *1STCLASS*, the *PC Magazine* electronic MCI mail agent, and its companion COM port driver, *COURIERS*.

The essential difference between *Lotus Express* and a normal communications program is that *Express* employs a special protocol, called Mail Link<sup>®</sup>, to communicate with MCI. Mail Link automates the uploading and downloading of data, which relieves you of the need to learn and use MCI commands. Additionally, and more importantly, by utilizing Mail Link, *Express* can convert arbitrary data—including binary code—to and from a standard ASCII format. This is what allows you to use MCI to ship your binary files.

*Lotus Express* is very big and powerful, and it's memory resident. It can run in the background and automatically dial MCI at regular intervals to upload and download mail while you're busy with other applications (assuming they'll fit in memory). *Express* has an editor of its own for composing e-mail and a reader for viewing incoming messages. And it sets up an extensively structured subdirectory system.

*1STCLASS* takes a less automated, stick-shift approach. You run it only when you want to send mail or binary files or

## 1STCLASS and COURIERS Make Binary Transfers Easy

■ If you're looking for an alternative to Lotus Express to send .COM, .EXE, spreadsheet, and other binary files over MCI Mail, here's the answer.

check your Inbox. You must use your own text editor or word processor to create or read messages, and you must set up and manage a subdirectory structure. *1STCLASS* does automate the MCI connection procedure, however, and it does translate binary data into ASCII format so you can send any PC file as an attachment to a message. Moreover, *1STCLASS* is compatible with *Express*, so users of either program can exchange files with users of the other.

### GETTING 1STCLASS

*1STCLASS* and *COURIERS* (you'll need both) can be downloaded in executable form from PC MagNet, as described in the sidebar "1STCLASS by Modem." Alternatively, you can download the source code and assemble it with a Microsoft or IBM macro assembler (Version 2 or later). The BASIC files are also available via PC MagNet; if run in BASIC, these will produce the same .COM files. If you don't have a modem, you can get both the assembly and BASIC listings by fax or mail by sending a request with your name and address to Utilities, *PC Magazine*, One Park Avenue, New York, NY 10016; At-

tention: Carolyn Falconer. (No phone calls please.)

*COURIERS* is a memory-resident program that must be loaded before *1STCLASS* can run. It provides a high-speed (2 to 115,200 bits per second) interrupt-driven driver for COM1 to COM4. *COURIERS* provides *1STCLASS* with a set of function calls that replace the inefficient routines available through the BIOS. I decided to make *COURIERS* a separate program from *1STCLASS* so that its services could be made available to other applications. Adventurous readers can experiment with *COURIERS* in their own programs. Since *COURIERS* takes up only about 1.5K of RAM, I didn't bother providing it with an uninstall option, although such an option could, of course, easily be incorporated.

The command syntax for *COURIERS* and *1STCLASS* is simply

*COURIERS*  
*1STCLASS*

That's it. No parameters or optional switches are needed. You could put both commands in a two-line batch file, or you could load *COURIERS* first (it won't load itself more than once) by including it in a line in your AUTOEXEC.BAT file. Of course, if you've ever used MCI before, you know there's got to be a little more to it than that.

Like all good communications programs, *1STCLASS* is driven by a script. Every time *1STCLASS* executes, it looks for a script file named *1STCLASS.CSF*



## Utilities

(communication script file). This set of instructions, which you must customize for yourself, tells ISTCLASS which COM port to use, what line speed to use, the telephone number to dial, your name and password, and so on. You can use the template in Figure 1 as a model for your own ISTCLASS.CSF. An explanation of the various commands you use to create and edit ISTCLASS.CSF is contained in the sidebar "Understanding ISTCLASS's Script Language." This sidebar also describes, step by step, how to prepare and address a message and how to specify files to be sent as attachments.

Each time you invoke ISTCLASS it attempts to call MCI Mail. (You should note that there are no built-in security precautions.) If the call is completed and the login accepted, ISTCLASS first uploads any outgoing messages you've prepared. You can use any word processor or editor that produces simple ASCII output to prepare your outgoing messages. After you have prepared a message, save it under a file-

name with an .OUT extension.

When ISTCLASS completes a connection to MCI, it scans the current directory for \*.OUT files and uploads them to your Outbox. Once MCI confirms that it has accepted a message, ISTCLASS renames the original file with an .MLD (mailed) extension. In the process, it wipes out any previous file of the same name, so be careful if you want to keep copies of messages you send.

ISTCLASS then downloads any messages waiting in your Inbox. It writes these to a file called MAIL.IN, again in the current directory. Should MAIL.IN exist already, any new text messages are appended to it. After running ISTCLASS, therefore, you will need to use a word processor or browse utility to read the mail, copy any messages you wish to save to other files, and then delete MAIL.IN.

ISTCLASS creates a unique file for every attachment it downloads. A pointer to each attachment file is inserted into the message that carries it. When you send a file as an attachment, however, the filename is not automatically included in the message. If this is important, you must indicate in your message text how the recipi-

ent should rename the attached file.

While running, ISTCLASS provides an ongoing screen commentary. It echoes some of its dialogue with your modem and then certain lines from its session with MCI. For each message it transfers, it pulls out and displays the most important items (the subject, for example) from the message header.

ISTCLASS also displays any error messages sent from MCI. If you receive a diagnostic message whose meaning is not immediately clear, and if you are not using an error-correcting modem, you should assume that the cause was a transmission error. You should then try your session again and see if the transmission goes more smoothly.

If you ever need to see *exactly* what has transpired between ISTCLASS and MCI, you can inspect the file ISTCLASS.LOG. ISTCLASS writes a full transcript of each session to this filename. This means, of course, that if you want to save a transcript, you must rename it or copy it to another file before you run ISTCLASS again.

After downloading, ISTCLASS ends the session, disconnects, and exits. If anything goes wrong, you can abort a session at any time by pressing the Esc key; all other keystrokes, including Ctrl-C, are ignored.

### LIMITATIONS

With ISTCLASS's assistance, MCI Mail is a wonderfully convenient medium for relaying *all* kinds of files to distant colleagues. Its usefulness even increases when data has to be sent to several people at a time. Note that although the binary-to-ASCII conversion technique used by both Express and ISTCLASS is not notably efficient, subscribers are charged according to the number of characters sent.

ISTCLASS has one limitation that is not shared by Lotus Express, however. Express incorporates an error-correcting protocol called X.PC. X.PC, a TYMNET invention, is in the same protocol class as MNP (Microcom Networking Protocol), which is commonly implemented in error-correcting modems. In order to keep its size within reasonable bounds for this column, ISTCLASS omits X.PC. This limitation will restrict ISTCLASS's use to those who possess suitable error-correcting modems (MCI supports MNP on one of its toll-free lines) and to those who, like myself, are blessed with phone lines that are rarely sullied by transmission errors.

TEMPLATE.CSF		COMPLETE LISTING	
C	"Calling MCI Mail on an 800 number" M"J"		
C	"(Press the Escape key if you need to abort the session.)" M"J"		
P 1	"2400" Your COM port number and speed go in this line		
T	"ATV1" M"		
R 5	"OK" M"J"		
T	"ATSM" M"		
R 5	"OK" M"J"		
T	"ATSD" M"		
R 5	"OK" M"J"		
D 1			
T	"ATL8" M"		
R 5	"OK" M"J"		
T	"ATE1" M"		
R 5	"OK" M"J"		
C	"		
C	"*1-800-234-6245 300/1200 baud for interactive use"		
C	"*1-800-456-6245 2400 baud for interactive use"		
C	"*1-800-825-1515 1200/2400 baud special number for Lotus Express,"		
C	" Link program"		
C	"*1-800-333-1610 1200/2400 baud for MNP use"		
C	"		
T	"ATDT9,18004566245" M"	Insert appropriate number here	
R 40	"CONNECT"		
B			
D 2			
T	"M"		
R 20	"Port:"		
R 5	"name:"		
T	"	Your username goes on this line	
T	" /batch:16T/"		
T	"	Your password goes on this line	
T	"M"		
R 20	"COM" M"J"		
H			
R 10	"CLR DTE" M"J"		
	"You will find any new mail in file MAIL.IN"		

Figure 1: You can use this script as a model to customize your own ISTCLASS.CSF script file. The modem commands shown use the Hayes Standard AT Command Set. If your modem uses a different command language, you must make the necessary modifications.

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## Utilities

Fortunately, there is no danger in attempting to use ISTCLASS on a noisy line. Checksums are employed to detect any damage that occurs while data is in transit. Since this version of ISTCLASS does not make use of the X-PC protocol, however, when an error is detected the session is simply aborted. This leaves the status of any incompletely handled messages unchanged. Thus, if an error kicks you out prematurely, all you need do is run ISTCLASS again to retry any pending transactions.

### HOW COURIERS WORKS

COURIERS was designed to supplant the inefficient and inadequate serial-port services built into IBM's BIOS. In an ideal world, many of the functions COURIERS adds would have been included in the original BIOS. COURIERS runs as a small (a little more than 1K) memory-resident program that can handle all four COM ports (COM1 through COM4) commonly installed on PCs; it can even operate two ports simultaneously. COURIERS drives COM ports using interrupts, and since in the standard configuration COM1 shares an interrupt line with COM3, it cannot operate these two together. The same is true for COM2 and COM4. These are hardware limitations to which any program is subject. The COURIERS program can configure a port to operate at any speed the hardware can handle—namely, from 2 bps up to 115,200 bps.

A program invokes COURIERS's services by means of interrupt 14h, which is reserved for BIOS serial services. The BIOS uses only function codes 0 through 3; COURIERS hooks the interrupt and takes over function codes from 80h up. If a program makes a request to the BIOS, COURIERS passes it through unchanged. [Note: Since a more detailed description of the functions offered by COURIERS can be found in this issue's Languages column as well as in the extended DOS-page file available on PC MagNet, only an overview will be presented here.—Ed.]

COURIERS handles input by reading characters into a circular buffer established in an area of memory provided by the calling program. It also unloads characters from that buffer on demand. Output can be performed either on a character-at-a-time or on a multicharacter basis. All input and

output operations, except single-character output, are performed using interrupts, so the calling program can continue with other processing while data transfer is in progress.

Although COURIERS has hooks for other functions, I have completed few beyond those that proved necessary for ISTCLASS. At the top of the source listing you will see the definition of a structure used to hold all the information pertaining to a port. This COM\_PORT structure holds both the constant parameters, such

**COURIERS runs as  
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simultaneously.**

as the I/O address and the interrupt vector number, and the variables used while a port is in operation. One instance of this structure is then declared for each port, COM1 through COM4. Next comes a switch, with a table of addresses for the various functions that COURIERS performs.

The coding in COURIERS is straightforward except for the usual strange things required to keep the serial I/O chip happy and a few oddities in the interrupt routines to make them fast. The heart of a PC serial port is a type 8250 (or equivalent) integrated circuit. The software manages this chip by reading and writing a set of registers in it; the offsets of these registers in the I/O-address space are defined near the start of the listing—be glad you don't have to discover all the little eccentricities of the 8250 for yourself!

The code proper starts with the interrupt routines. There is one entry point for each

COM port with code that grabs the address of the corresponding port table and then jumps to a common interrupt handler. The next step is to determine which of four possible events caused the interrupt: the receipt of a character; the emptying of the transmission buffer (implying the port's readiness to accept another character for transmission); a change in state on one of the modem control lines (DCE ready, carrier detect); or the detection of a condition such as a parity error. The COURIERS program ignores interrupts of the third and fourth types.

Once the interrupt has been handled, an acknowledgement must be given both to the port itself and to the PC's interrupt controller. The former step involves momentarily clearing a bit in the OUT2 register of the 8250. Here, and in many other places like it in the source listing, you will see an instruction of the form `JMP $+2`. This anomalous bit of code is deliberately inserted to do nothing more than waste some time between two I/O operations to the COM port. On a PC with a fast processor, if two such operations are done in quick succession, the 8250 may not handle the first one fast enough to be ready for the second. Such forced delays are not uncommon in serial I/O drivers.

The routines for handling the receive and transmit interrupts would be almost trivial were it not for the requirement that they cope with flow control. MCI Mail, like many other systems, uses Ctrl-S and Ctrl-Q (also known as XOFF and XON) for this purpose. Flow control operates bidirectionally: when one partner is receiving data, it can regulate the flow from the other by sending a Ctrl-S to squelch transmission temporarily. A Ctrl-Q will then restart it.

The receive interrupt routine, `RX_INT`, unloads the character from the port along with a byte's worth of status information about it. This makes a word of data, which is stuffed into a circular buffer set up for the port. Should the buffer overflow, the highest status bit (which has no other meaning) is turned on to record this condition. The buffer pointer stored in the `COM_PORT` table is then updated.

When the port is configured for input flow control, a check of how full the buffer is is made for every eighth character received. When the buffer becomes more than three-quarters full, a Ctrl-S message is sent, suspending the data. The function that unloads data from the input buffer, `F_READ`, takes care of the other half of in-

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## Utilities

put flow control, sending a Ctrl-Q message after the fill point falls below the 50 percent mark.

The transmit interrupt handler, TX\_INT, checks the port's output pointer

to see if any data is being sent. If output is in progress, then the next byte is extracted from the buffer, the pointer incremented, and the byte presented to the port. If the byte sent is the last, then the pointer is zeroed.

The INTERCEPT4 function catches calls to the BIOS-serial-services interrupt. If the function code in AH is less than 08h,

a jump is made to the BIOS; otherwise the entire set of processor registers (except AX and BP) is saved and PROCESS is called to handle a COURIERS function.

There is one other procedure in the COURIERS program that deserves some discussion: GET\_DIVISOR converts a line speed in bits per second (for example, 2,400) into the corresponding clock divi-

## UNDERSTANDING 1STCLASS'S SCRIPT LANGUAGE

by Pete Maclean

In preparing 1STCLASS.CSF, a model for which is shown in Figure 1, you must use the correct command syntax. 1STCLASS does no syntax checking of its script commands, and mistakes can result in strange behavior.

The generalized command form is

```
C [num] [{"str"} [comment]
```

The C variable is a single capital letter that stands for the command itself. The command letter must occupy the first character position in a single line of up to 80 characters. All the permissible values for C are listed in Figure A.

Also shown in Figure A: Some commands require a numeric argument, num, which is expressed in decimal integers from 0 to 255. Other commands take a string argument, "str", which must be enclosed in quotation marks. Control characters included in a "str" are designated with a preceding caret (^). For example, ^M means Carriage Return, and ^J stands for Line Feed. Any actual control characters embedded in a string by using the Ctrl key are discarded.

Some commands take arguments of both kinds, some take just one, and others take none at all; Figure A lists their requirements. Any number of blank spaces may separate the various command-line components, and the last argument required by a command may be followed by a free-form comment up to the 80-character line-length limit.

### PREPARING OUTGOING MESSAGES

Outgoing messages should be composed, one per file, in pure ASCII. Each message must have an envelope and a message text; it may also have one or more attachments; and each message file must use an .OUT exten-

sion. Here is a brief example:

```
TO: Emma Peel
TO: John Steed
CC: Nancy Parks
Subject: Production Meeting
```

The message text starts here...

The envelope is a fixed-format set of lines that appears at the beginning of a message and identifies the addressees and the subject. It's a good idea to make a template envelope for each frequent correspondent or group. Then each time you send a message to that party, you'll only have to insert the envelope at the start of the message and edit its subject field.

The basic elements of an envelope are TO: lines, CC: lines, and SUBJECT: lines. An envelope must start with a TO: line. You may follow it with as many more TO: lines as you wish, and then with any number (if any) of CC: lines. There must be exactly one TO: or CC: line per addressee.

The colon shown after each keyword in the envelope is essential. On the other hand, MCI doesn't care whether you enter its keywords in uppercase, lowercase, or mixed cases. You may also include any blank spaces you wish between the colon and the next word, but no line in any part of a message should have more than 80 characters.

The envelope is normally completed by a single SUBJECT: line, though this may be omitted. The envelope must be separated from the message text by a blank line.

You should not put a FROM: line in an envelope. MCI Mail does that for you. It also inserts a line that documents the time and date that the message was

mailed (which may be useful later).

If the addressee's name is unique among MCI Mail subscribers, then (assuming you spell it precisely) it is sufficient identification for the TO: or CC: lines. If you know the party's MCI Mail ID, however, it is wise to include that number. Moreover, if the name is not unique, some other item of information must be included to identify the addressee, and the ID number is the surest. Just follow the name with a slash and then the number, as in

```
TO: Emma Peel/123-4567
```

When sending to a fax machine, your envelope should list the name of the recipient on the TO: or CC: line and then add lines such as:

```
TO: Emma Peel
EMS: FAX
MBX: Phone: 415-555-5555
```

For telex machines the procedure is very similar. The name of the intended recipient goes on the TO: or CC: line, followed by the full telex number and answerback:

```
TO: John Steed
TLX: 123456789 BROLLY
```

Finally, to send your message to a CompuServe subscriber, put his name on the TO: or CC: line, and then complete the address:

```
TO: Miles Pickens
EMS: COMPUERVE
MBX: 22222,222
```

The MBX: line carries the CompuServe ID of the addressee.

Messages may be directed to ad-

## Utilities

sor the 8250 uses to time the transmitted and received bits. The formula for calculating this divisor is

$$\text{divisor} = 115,200 / \text{line\_speed}$$

There's a trick in this procedure to make it handle two different speed ranges separately. The top speed a COM port can handle (115,200 bps) is the only speed which, expressed as a count of bits per second, does not fit into a 16-bit word. In order to express all speeds as word quantities, therefore, I use the convention that zero actually means 115,200. The next-fastest

speed that a COM port can handle is 57,600 bps.

Although COURIERS includes a check to prevent its being loaded more than once, it has no provision for unloading itself from memory. Given its small size and the low probability that it could conflict with any other software, this hardly seems a limitation.

addressees in any combination of these categories. For more information on creating addresses (except for faxes) see *The Complete MCI Mail Handbook* by Stephen Manes.

### ATTACHMENTS

Attachments are PC files that are to be sent along with a message. They are permitted, indeed they make sense, only for messages that are directed to other MCI Mail subscribers. Attachments are specified by special commands recognized by 1STCLASS that are placed at the end of the message. The format is

#### ATTACH FILENAME description

1STCLASS expects any line that begins with an exclamation point to contain a command of this type. The exclamation mark must appear in the first character position. Any number of attachments may be added, one per line. Any lines in a message file following attachment commands are ignored. For each !ATTACH the named file is delivered along with the description.

Here's an example of a message with two attachments:

To: John Steed/283-6437

Subject: New version of 1STCLASS

Here are the source and executable of the latest version of 1STCLASS.

ATTACH 1STCLASS.ASH source

ATTACH 1STCLASS.COM executable

When 1STCLASS receives a message with attachments, it writes each to a separate file in the current directory called ATTACHED.xxx, where xxx is replaced by a unique extension. A notice is appended to the incoming message to alert the recipient about the attachment(s) and their filename(s).

PC MAGAZINE HOW TO CREATE AND EDIT A SCRIPT FILE	
Command	Description
P	Specifies COM port (1, 2, 3, or 4) for num and the line speed for "str". There are no defaults for these parameters. A P command must appear in every script before any T or R command is listed. Example: P 2 "1200"
C	No num; used as "str", writes a comment to the screen. Example: C "This is a comment "M"J"
D	Delays (pauses) for num seconds; no "str", no default. Example: D 15
T	No num; transmits a string ("str"). See B for example.
R	Waits num seconds (timeout) for a specified "str" to be received. The default num value of 0 tells 1STCLASS to wait forever. The user can abort the script by pressing Esc. See B for example.
B	No num, no "str". The B command resets the bit-per-second rate of a multispeed modem. The following sequence, for example, would dial up, wait 40 seconds, then change your modem speed on the basis of the "CONNECT" message: T "ATDT123-4567" M R 40 "CONNECT" B
M	No num, no "str"; enters Mail Link processing in "master" mode. Any script file for calling MCI must contain an M command; it marks the point at which 1STCLASS should switch into a Mail Link session. Once that session terminates, execution of the script file continues.

Figure A: When the 1STCLASS program executes, it looks for the script file 1STCLASS.CSF, a model of which is shown in Figure 1, to find out which COM port to use, the required line speed, the telephone number to dial, and so forth. You can customize this script file by using these commands. Some commands require a numeric argument, some require a string argument, and some require both. However, some do not require any at all.

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## 1STCLASS BY MODEM

The programs published in *PC Magazine* are available by modem from PC MagNet.

To download 1STCLASS.COM, and COURIERS.COM, log on to PC MagNet. Enter GO UTILITIES or choose PC MAGAZINE UTILITIES from the top menu, then DIRECT UTILITY DOWNLOAD from the next. Enter the filename, then select the file from those presented. Answer (Y) to DO YOU WISH TO DOWNLOAD? Press Enter to see the transfer protocols. Choose a protocol and download the file.

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*Photocopy this page. Trim, hole-punch, and add to your manual.*



Pete Maclean

November 14, 1989 (Utilities)

**Purpose:**

1STCLASS helps you manage your MCI mail as well as send and receive ASCII and/or binary files. It requires the use of COURIERS, a 1.5K TSR serial port driver program, and a customized script file, 1STCLASS.CSF.

**Format:**

COURIERS  
1STCLASS

**Remarks:**

**Troubleshooting Tips:** If MCI finds faults with a message 1STCLASS uploads, an explanation will be displayed. Such diagnostics are not written to 1STCLASS.IN but, if you lose the display, you can always find it in MAIL.LOG.

The most common problem is misformatted envelopes. For a message to be delivered, the subscriber must be exactly identified. If you address a message to a name that's not unique, the IDs of all subscribers with the name are listed:

At least one problem with envelope

608 More than 1 MCI Mail user matches recipient information

MCI ID	Name	Organization	Location
000-0000	Zoltan Shah	Whizzo Chocolate	New York, NY
111-1111	Zoltan Shah	Sunshine Desserts	Fresno, CA

Select the right one and edit your message to include the ID. Remember that the name should be separated from the ID by a slash, as in Zoltan Shah/111-1111. In fact, an ID alone is a perfectly acceptable address.

If MCI objects to something in the envelope of a message, you may receive a response such as

At least one problem with envelope

610 Improper information in the envelope

SUBJECT: 1STCLASS

This text is part of the message...

In this case, the blank line needed to terminate the envelope was missing. Other causes might be a mistyped keyword on an envelope line or the appearance of lines in an order that MCI cannot handle.

Some errors cause MCI to stop responding; a message having two or more addresses on a line is an example of this. A message may be addressed to any number of people, but each address must be on a separate TO: or CC: line.

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## Utilities

### HOW 1STCLASS WORKS

A reader who is experienced with the kind of software that implements protocols might expect our 1STCLASS utility to be an elegant table-driven program. Such is not quite the case: in order to keep it compact I coded it in a slightly messy way. Many corners—especially in error processing—were cut to keep it small; however, experience shows it to be a very reliable program.

The main procedure, ENTRY, checks that COURIERS is loaded and that the script file, 1STCLASS.CSF, is present. Then it opens the file MAIL.IN to receive incoming mail. If all this happens without error, the procedure SCRIPT is called to process the script, and finally COURIERS is called to deconfigure the COM port once all is done.

SCRIPT is the central procedure. It reads the script file line by line, interpreting each command. It evaluates the numeric argument, if present, strips the quotation marks from the string argument, if present, and then calls the procedure that handles the command in question. All of the command processors are called SCRIPT\_XXX, where XXX is the name of the command.

The only element in the 1STCLASS program that may be unusual is the use of in-line arguments for the TTY\$ procedure. The TTY\$ procedure invokes DOS service 9 to display a canned message terminated by a dollar sign. A call to this procedure would appear as

CALL	TTY\$
DM	STRING

TTY\$ manipulates the stack pointer to get its argument, then increments the return address to point to the byte past DW. In-line arguments may save a little memory with a procedure that's always called with a literal argument.

A Mail Link session involves two stages, with the partners playing alternate roles. In 1STCLASS's Mail Link emulations, I've denominated these as *master* and *slave*. The master sends Mail Link commands to the slave, which returns Mail Link responses. The partner acting in the master role is also the one who gets to send messages. Once a connection with MCI Mail is completed, 1STCLASS as-

sumes the master role and uploads any waiting messages. Once all outgoing messages have been delivered to MCI, 1STCLASS sends a command to switch the roles. 1STCLASS then becomes the slave and MCI gets its chance to download messages.

The master role is managed by the procedure MASTER and the slave role by the procedure SLAVE. As you study MASTER, you will see that 1STCLASS makes several assumptions about MCI Mail doing what it is supposed to do. So far, I've found that these assumptions have been quite safe. MASTER calls the OUTGOING procedure to dispatch any pending messages. OUTGOING searches for all files with names that match the pattern \*.OUT and for each one calls MAILER to send it off. The procedure then renames the file, giving it an .MLD extension. SLAVE repeatedly waits for a Mail Link command to arrive, verifies its checksum, then calls the appropriate procedure to process it.

### TRY IT YOURSELF

I've been using the 1STCLASS and COURIERS utilities for the last year to serve my own everyday needs in interfacing with MCI Mail. I typically run 1STCLASS once at the beginning and once more at the end of each business day, and it hasn't failed me yet.

At the same time, as a programmer, I do not regard either of these programs as finished projects. There are several directions in which I would like to expand them. The first is to add the missing protocol, X.PC, to the COURIERS program. Second, it would be nice to give the 1STCLASS program the ability to construct its own envelopes, keeping a little database of a user's frequent correspondents, prompting the user for other necessary details, and automatically converting the envelopes of received messages into a form suitable for sending replies.

Although I had already been a user of MCI Mail for several years, I was amazed to find how much I still had to learn about this excellent service. To this end, I can do no better than to recommend to others what I found most valuable: Stephen Manes's *The Complete MCI Mail Handbook* (Bantam Books, 1988).

*Pete Maclean, a Scotsman living in San Francisco, is a consultant who specializes in software development, training, and troubleshooting for computer networks.*

# Environments

When Pierre Bézier began his pioneering work in computer modeling in the 1960s, he probably didn't realize the extent to which his work would eventually find its way into mainstream computer graphics. An engineer with the French automobile company Renault, Bézier used a computer program called UNISURF to develop methods for defining the curvature of car-body panels.

At the time, car-body panels were designed on paper, using simple drawing tools such as french curves. Clay models would be constructed, and, after that, stamps and dies for creating the panels. In the late 1950s, however, the advent of hardware that could create the dies directly from mathematical specifications dictated a new approach to defining shapes.

The Bézier spline was part of the mathematics developed to assist in this process. Traditionally, a *spline* was a thin, flexible piece of wood that could be anchored at noncolinear points to form a curve. In my early days, I used a spline constructed from thin metal and long springs to interpolate between points on a graph. Such devices have gone the way of the slide rule, of course. Splines are now mathematical formulas processed by a computer.

What has all this to do with us? Well, unlike many other graphics systems in common use on personal computers, it happens that the Graphics Programming Interface (GPI) component of the OS/2 Presentation Manager has built-in support for Bézier splines. Indeed, the inclusion of Bézier splines is rightly considered one of the big selling points of GPI.

Let's examine these curves and see why they're so important, restricting ourselves to two-dimensional Bézier splines—the kind supported by the GPI. Later in the article I'll discuss how the Bézier spline is derived, using both a geometrical and mathematical analysis.

## Understanding and Using Bézier Splines in OS/2 Graphics

■ As the need for better text display enlarges the role of vector-based rather than bitmapped fonts, the need for GPI support for Bézier splines becomes increasingly important.

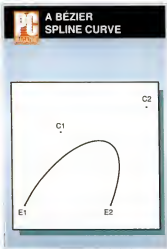


Figure 1: Although the control points (C1 and C2) affect the curvature of a spline, usually a curve doesn't pass through these points—only through the endpoints (E1 and E2).

points and two control points. In this article, I'll call the end points E1 and E2 and the control points C1 and C2. The curve begins at E1 and ends at E2. The curve generally does not pass through C1 and C2; instead, the control points affect the curvature of the line. Figure 1 shows a sample Bézier spline curve, with the four points labeled.

In computer graphics, the Bézier spline is probably the most important type of curved line after the ellipse. Bézier splines are still a valuable tool in computer-aided design (CAD), of course, but they also have powerful applications in a different area of computer graphics that is not at all like CAD.

Which area of computer graphics? Would you believe . . . text?

Yes! It turns out that Bézier splines are extremely useful in the definition of fonts based on vector outlines. As I discussed in my last two columns, text display is an increasingly crucial part of computer graphics. Vector-based fonts give the programmer and the user maximum flexibility in manipulating and displaying text. Bézier splines prove to be nearly ideal for defining the curves in the characters of these vector fonts.

Thus, a graphics system that supports the generation of fonts based on vector outlines must also support Bézier splines if the graphics system is to render attractive text.

Many computer graphics systems are behind the times in this respect. Macintosh QuickDraw, the Microsoft Windows Graphics Device Interface (GDI), the Unix X Window system, and the Graphical Ker-

### USING BÉZIER SPLINES

A Bézier spline in two dimensions is a curved line defined by four points: two end

## Environments

nel System (GKS)—none of these graphics systems supports Bézier splines. (That's not to say that an application can't implement Bézier splines itself. Micrografix's *Designer*, which runs under *Windows*, can draw Bézier splines, but these are generated from lots of very short straight lines.)

The graphics programming languages that do support Bézier splines are usually those that deal largely with text and vector-based fonts. For example, PostScript, the page-definition language developed by John Warnock and Adobe Corp., has the *curveto* operator that draws a Bézier spline based on four points. In fact, the Bé-

**The move to  
vector-based fonts  
should make  
Bézier spline support  
virtually standard  
within a few years.**

zier spline is the only type of curve that PostScript implements. PostScript has several functions that draw *arcs* (curves on the circumference of an ellipse), but these are approximated using one or more *curveto* functions.

Another graphics language that makes use of Bézier splines is Donald Knuth's METAFONT, which was developed specifically for the creation of typefaces. This language is not exactly mainstream, of course, but it indicates how people interested in the generation of fonts place a high value on the Bézier spline.

I think the Bézier spline will make its way into the mainstream as well, as indicated by GPI. The move to vector-based fonts (not only in GPI, but in other graphics systems as well) should make Bézier spline support virtually standard within a few years.

Although the GPI supports Bézier splines, the vector fonts it currently implements do not make use of them! These



Figure 2: This file automates the creation of BEZIER.EXE.

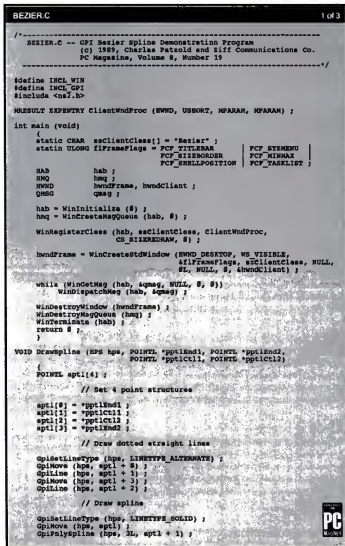


Figure 3: Here's the source code to create the sample curve-drawing program, BEZIER.EXE.

BEZIER.C

2 of 3

```

HRESULT EXPTNTY ClientWndProc (HWND hwnd, USHORT msg,
                                WPARAM mp1, LPARAM mp2)
{
    static BOOL fButton1Down, fButton2Down ;
    static POINTL ptlEnd1, ptlEnd2, ptlCtl1, ptlCtl2 ;
    HPS hps ;
    SHORT cxClient, cyClient ;

    switch (msg)
    {
        case WM_SIZE:
            cxClient = SHORT1FROMWPARAM (mp2) ;
            cyClient = SHORT2FROMWPARAM (mp2) ;

            ptlEnd1.x = cxClient / 3 ;
            ptlEnd1.y = cyClient / 2 ;

            ptlEnd2.x = 2 * cxClient / 3 ;
            ptlEnd2.y = cyClient / 2 ;

            ptlCtl1.x = cxClient / 2 ;
            ptlCtl1.y = 3 * cyClient / 4 ;

            ptlCtl2.x = cxClient / 2 ;
            ptlCtl2.y = cyClient / 4 ;

            return 0 ;

        case WM_BUTTON1DOWN:
            if (!fButton1Down)
            {
                WinSetCapture (HWND_DESKTOP, hwnd) ;
                fButton1Down = TRUE ;
            }
            else
                WinAlarm (HWND_DESKTOP, WA_ERROR) ;

            break ;

        case WM_BUTTON2DOWN:
            if (!fButton2Down)
            {
                WinSetCapture (HWND_DESKTOP, hwnd) ;
                fButton2Down = TRUE ;
            }
            else
                WinAlarm (HWND_DESKTOP, WA_ERROR) ;

            break ;

        case WM_BUTTON1UP:
            if (fButton1Down)
            {
                WinSetCapture (HWND_DESKTOP, NULL) ;
                fButton1Down = FALSE ;
            }

            break ;

        case WM_BUTTON2UP:
            if (fButton2Down)
            {
                WinSetCapture (HWND_DESKTOP, NULL) ;
                fButton2Down = FALSE ;
            }

            break ;

        case WM_MOUSEMOVE:
            if (!fButton1Down && !fButton2Down)
                break ;

            hps = WinGetPS (hwnd) ;
            GpiSetColor (hps, CLR_BACKGROUND) ;
            DrawSpline (hps, ptlEnd1, ptlEnd2, ptlCtl1, ptlCtl2) ;

            if (fButton1Down)
            {
                ptlCtl1.x = MOUSEMSG(msg)->x ;
                ptlCtl1.y = MOUSEMSG(msg)->y ;
            }
            else
            {
                ptlCtl2.x = MOUSEMSG(msg)->x ;
                ptlCtl2.y = MOUSEMSG(msg)->y ;
            }
    }
}

```

fonts instead use another GPI curve known as the *fillet*—possibly because of its faster performance. I suspect, however, that any enhancements to GPI's vector font technology will involve the use of splines rather than fillets.

#### THE GPI SPLINE-DRAWING FUNCTION

To draw a Bézier spline in a Presentation Manager program, you use the `GpiPolySpline` function. `GpiPolySpline` draws one or more connected Bézier spline curves, beginning at the current position. (A program can set the current position by calling `GpiMove`; the current position is also set by other line-drawing functions at the end of the lines they draw.)

`GpiPolySpline` has the following general syntax:

```

GpiPolySpline (hps, lPoints,
               aptl) ;

```

The first parameter is a handle to a presentation space. The last parameter is an array of `POINTL` structures. (A `POINTL` structure has two fields, named *x* and *y*, and describes a point in a two-dimensional coordinate system.) The second parameter indicates the number of `POINTL` structures in this array. This number must be a multiple of 3.

To draw one spline curve, you need an array of three `POINTL` structures. The `GpiPolySpline` function draws a curve from the current position to `aptl[2]`, using `aptl[0]` and `aptl[1]` as the control points, as shown below:

```

E1 = Current Position
C1 = aptl[0]
C2 = aptl[1]
E2 = aptl[2]

```

When you specify six points in the array, the function draws two connected Bézier splines. The second curve continues from `aptl[2]`, thus:

```

E1 = aptl[2]
C1 = aptl[3]
C2 = aptl[4]
E2 = aptl[5]

```

The `GpiPolySpline` function sets the current position to the last point in the array (for example, `aptl[2]` for three points, and `aptl[5]` for six points).

The use of `GpiPolySpline` to draw two or more connected Bézier curves can be a little tricky. In general, the resultant com-

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## Environments

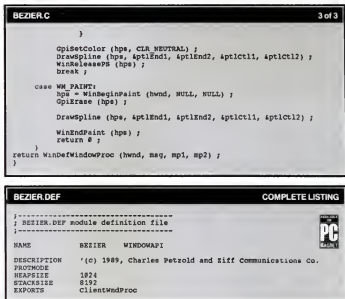


Figure 4: LINK uses the information in this definition file to construct BEZIER.EXE.

posite curve will not be smooth at the point where the curves meet. If you want a smooth composite curve (using the example of two curves shown above), then `aptl[1]`, `aptl[2]`, and `aptl[3]` must be colinear (that is, the three points must lie in the same line), with `aptl[2]` somewhere between the other two points.

### PLAYING WITH SPLINES

Before tackling the theory, you may want to experiment with Bézier splines. You can do this with the BEZIER program shown in Figures 2, 3, and 4.

If you have Microsoft C 5.1 and the Microsoft *Presentation Manager Softset* or *Programmer's Toolkit* installed (or the equivalent IBM tools), you can create BEZIER.EXE by running

**MAKE BEZIER**

You can also download all the source code and BEZIER.EXE from PC MagNet.

When BEZIER begins execution, it sets the two end points and two control points as you see them in Figure 5. These points are reset to this initial configuration whenever you change the size of the pro-

gram's window.

The program draws a Bézier curve that connects the two end points, E1 on the left and E2 on the right. The first control point (C1) is near the top of the window, and the second control point (C2) is near the bottom. The program also draws dotted lines from E1 to C1 and from C2 to E2. (I'll discuss the significance of these lines a little later.)

The two end points are fixed in place by the program, but you can move the two control points with the mouse. You can move the first control point by pressing the left mouse button while the mouse pointer is positioned over the window. The right mouse button lets you move the second control point. As you move the mouse with either button pressed, the curve is erased and redrawn, so you can see how the curve changes as you move the control points.

If you move the first control point to the upper-left corner of the window and the second control point to the upper-right corner, the program will draw the Bézier spline shown in Figure 6. Switching the positions of the two control points causes a loop to appear in the Bézier spline curve,

## Environments

as seen in Figure 7. Bézier spline curves with loops are not frequently encountered in common practice.

### BÉZIER SPLINE CHARACTERISTICS

As you'll probably discover when experimenting with the BEZIER program, the Bézier spline lends itself well to interactive design. With a little practice, it becomes fairly easy to use the control points to pull the curve into a desired shape. The control points act on the line like magnets, in a fairly intuitive way.

Other characteristics of the Bézier spline also make it suitable for use in interactive design. Although some forms of spline curves do not touch any of the points used to define them, the Bézier curve always passes through the two end points. This anchors at least part of the curve in place.

If you think of the curve as being drawn from E1 to E2, then at E1 the curve is tangent to a straight line that runs from E1 to C1. (The dotted lines drawn by the BEZIER program help indicate this.) Similarly, at the point E2, the curve is tangent to the straight line that moves from C2 to E2.

Some complex curves have irregularities for certain combinations of points—this can cause strange behavior in the curve. The Bézier spline, by contrast, stays under control. Specifically, the curve is always bounded by the four-sided convex polygon (sometimes called a *convex hull*) that you can visualize by connecting the two end points and the two control points.

This polygon is not always defined in the same way. For example, the Bézier curve in Figure 5 is bounded by the polygon formed by connecting E1 to C1 to E2 to C2 back to E1. Figure 6 shows a Bézier curve that is bounded by a polygon from E1 to C1 to C2 to E2 back to E1. In Figure 7, the bounding polygon is from E1 to C2 to C1 to E2 back to E1. These three examples account for all the possibilities.

Most importantly, Bézier spline curves are pleasing to the eye. This is surprising, considering that very little information is required to define the curve and considering how easy it is to manipulate them.

Bézier spline curve can be derived geometrically. This is probably not something you want to spend a lot of time doing with pencil and paper, but I think you'll find it interesting to go through the process at least once.

You begin by drawing three lines, connecting E1 to C1 to C2 to E2, as shown in Figure 8, Step 1. You then connect the midpoint of the line from E1 to C1 with the midpoint of the line from C1 to C2, and connect the midpoint of the line from C1 to

Figure 5:  
This is the  
initial window  
that is produced  
by the  
BEZIER.EXE file.

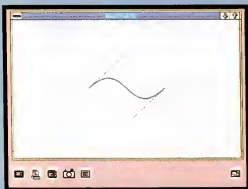


Figure 6:  
A different Bézier  
curve that was  
created by moving  
the control points.

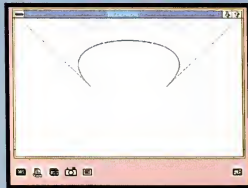
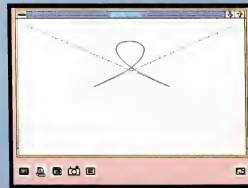


Figure 7:  
Switching the  
positions of the  
control points  
creates a Bézier  
spline curve  
with a loop.



### THE GEOMETRIC DERIVATION

In *The METAFONT Book* (Addison Wesley, 1986), Donald Knuth describes how a

## Environments

C2 with the midpoint of the line from C2 to E2. Then you should draw another line connecting the midpoints of the two new lines, as shown in Step 2. The three lines that you have just drawn are labeled (1), (2), and (3).

Now you can do the same thing using the four points E1, the leftmost end of line (1), the intersection of line (1) and line (3),

and the midpoint of line (3), and also using the four points E2, the rightmost end of line (2), the intersection of line (3) and line (2), and the midpoint of line (3). This procedure will create six new lines, as shown in Step 3.

If you keep following this procedure (the next step involves the creation of 12 new lines), you'll eventually approach the Bézier spline curve, as shown in Step 4. This demonstrates that the Bézier spline curve is an interpolation (of sorts) between four separate points, done in a way that

will ensure that the curve will pass through the two end points.

### THE MATHEMATICAL REPRESENTATION

Of course, no discussion of the Bézier spline would be complete without the heavy math. Although you don't have to worry about this when using Bézier splines in a Presentation Manager program, you may be surprised at the relative simplicity of the curve formulas. (On the other hand, if you're not accustomed to stuff like this, you may be surprised at the complexity of the formulas!)

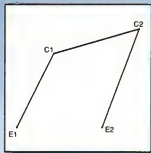
The Bézier spline curve is a cubic, which means that the formulas involve variables taken to the third power. It is expressed in terms of parametric equations, in which variables  $x$  and  $y$  are functions of

Although you don't have to worry about the math when using Bézier splines in a Presentation Manager program, you may be surprised at the relative simplicity of the curve formulas.

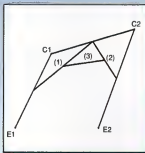


### HOW TO DERIVE A BÉZIER CURVE GEOMETRICALLY

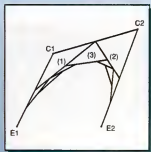
#### STEP 1



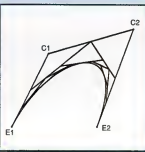
#### STEP 2



#### STEP 3



#### STEP 4



**Figure 8:** In order to understand how a Bézier spline curve is formed, you need to follow these steps: First, draw three lines that connect the end points and the control points. Next, connect the midpoints of each of these lines. Repeat this process twice more. If you were to continue this pattern, you would eventually approach a Bézier curve.

a third variable, often called  $t$ . You can think of  $t$  as "time," ranging from 0 at the beginning of the line to 1 at the end of the line.

The general form of a parametric cubic equation in two dimensions is

$$\begin{aligned}x(t) &= a_x t^3 + b_x t^2 + c_x t + d_x \\y(t) &= a_y t^3 + b_y t^2 + c_y t + d_y\end{aligned}$$

where  $t$  ranges from 0 to 1. The  $a$ ,  $b$ ,  $c$ , and  $d$  are constants. To derive these constants for the Bézier spline, we need some assumptions.

I'll have to abandon my earlier notation ( $E1$ ,  $E2$ ,  $C1$ , and  $C2$ ) here, and instead refer to the four points in terms of subscript-

# Cocaine can make you blind.

Cocaine fools your brain.

When you first use it, you may feel more alert, more confident, more sociable, more in control of your life.

In reality, of course, nothing has changed. But to your brain, the feeling seems real.

---

## From euphoria...

---

You want to experience it again. So you do some more coke.

Once more, you like the effects. It's a very clean high. It doesn't really feel like you're drugged. Only this time, you notice you don't feel so good when you come down. You're confused, edgy, anxious, even depressed.

Fortunately, that's easy to fix. At least for the next 20 minutes or so. All it takes is another few lines, or a few more hits on the pipe.

You're discovering one of the things that makes cocaine so dangerous.

It compels you to keep on using it. (Given unlimited access, laboratory monkeys take cocaine until they have seizures and die.)

If you keep experimenting with cocaine, quite soon you may feel you need it just to

function well. To perform better at work, to cope with stress, to escape depression, just to have a good time at a party or a concert.

Like speed, cocaine makes you talk a lot and sleep a little. You can't sit still. You have difficulty concentrating and remembering. You feel aggressive and suspicious towards people. You don't want to eat very much. You become uninterested in sex.

---

## To paranoia...

---

Compulsion is now definitely addiction. And there's worse to come.

You stop caring how you look or how you feel. You become paranoid. You may feel people are persecuting you, and you may have an intense fear that the police are waiting to arrest you. (Not surprising, since cocaine is illegal.)

You may have hallucinations. Because coke heightens your senses, they may seem terrifyingly real.

As one woman overdosed, she heard laughter nearby and a voice that said, "I've got you now." So many people have been totally convinced that

bugs were crawling on or out of their skin, that the hallucination has a nickname: the coke bugs.

Especially if you've been smoking cocaine, you may become violent, or feel suicidal.

When coke gets you really strung out, you may turn to other drugs to slow down. Particularly downers like alcohol, tranquilizers, marijuana and heroin. (A speedball—heroin and cocaine—is what killed John Belushi.)

If you saw your doctor now and he didn't know you were using coke, he'd probably diagnose you as a manic-depressive.

---

## To psychosis...

---

Literally, you're crazy.

But you know what's truly frightening? Despite everything that's happening to you, even now, you may still feel totally in control.

That's the drug talking. Cocaine really does make you blind to reality. And with what's known about it today, you probably have to be something else to start using coke in the first place.

Dumb.

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Naturally, every PS/2<sup>®</sup> with Micro Channel runs DOS and OS/2<sup>™</sup>. So with OS/2 Presentation Manager<sup>™</sup>, you can do multiple tasks concur-



# PS/2 it!

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## Environments


BEZIER SPLINE FORMULA	COMPLETE LISTING
$x(t) = (1-t)^3x_0 + 3t(1-t)^2x_1 + 3t^2(1-t)x_2 + t^3x_3$ $y(t) = (1-t)^3y_0 + 3t(1-t)^2y_1 + 3t^2(1-t)y_2 + t^3y_3$	

Figure 9: The mathematical formula for creating the Bézier spline curve, which joins two end points under the influence of two control points.



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CIRCLE 149 ON READER SERVICE CARD

ed values of  $x$  and  $y$ , as shown below:

$$\begin{aligned} E1 &= (x_0, y_0) \\ C1 &= (x_1, y_1) \\ C2 &= (x_2, y_2) \\ E2 &= (x_3, y_3) \end{aligned}$$

We make four assumptions. The first is that the curve passes through the point  $(x_0, y_0)$  when  $t$  is zero. Thus:

$$\begin{aligned} x(0) &= x_0 \\ y(0) &= y_0 \end{aligned}$$

The second assumption is that the curve passes through the point  $(x_3, y_3)$  when  $t$  equals 1:

$$\begin{aligned} x(1) &= x_3 \\ y(1) &= y_3 \end{aligned}$$

The third and fourth assumptions involve the first derivatives of the two formulas. This governs the slope of the line at the end points. For the beginning of the curve, the assumptions are

$$\begin{aligned} x'(0) &= 3(x_1 - x_0) \\ y'(0) &= 3(y_1 - y_0) \end{aligned}$$

Similarly, at the end of the curve:

$$\begin{aligned} x'(1) &= 3(x_3 - x_2) \\ y'(1) &= 3(y_3 - y_2) \end{aligned}$$

Armed with these equations, you can solve for the constants  $a_x$ ,  $b_x$ , and so forth in terms of  $x_0$ ,  $x_1$ , and so forth. Putting those constants back into the parametric formulas shown above and performing a bit of algebraic manipulation yields the common form of the Bézier spline formulas shown in Figure 9. There is a certain internal symmetry in these formulas that is very appealing, don't you think?

### WHAT DO WE DO WITH THEM?

Bézier splines in the GPI probably will have their greatest application in internal font generation and in CAD and drawing programs. It's possible that many programmers working with the PM will never have the occasion to use GpiPolySpline. Fair enough—at least you'll appreciate this facility a little more if and when GPI's vector font generation is enhanced.

But if there comes a time when you need to draw a complex image involving curves, and ellipses are not quite right, keep the Bézier spline in mind. It's a very flexible and powerful drawing tool. ■



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by  
Ray Duncan

# Power Programming

## Arithmetic Routines For Your Computer Programs, Part 1

If you program in C, you rarely need concern yourself with the mechanics of arithmetic in your applications. You simply declare your variables as long or short, signed or unsigned, integer or floating. You can then trust the compiler to translate the arithmetic operators in your source code into the proper machine instructions, sequences of instructions, or calls to library routines. You can even mix data types if you wish (multiplying a floating point number by an integer, for example); the compiler will generate the appropriate code to convert (or "coerce") the type of one piece of data to match the other.

In assembly language programming, on the other hand, you can't avoid the issues of computer arithmetic and data typing. You must have a solid grasp of signed and unsigned two's complement arithmetic, the CPU's built-in support for the basic arithmetic operations, and the algorithms by which more complex arithmetic operations can be constructed out of the available machine instructions.

In the next several columns, we'll explore some of these subjects together. We will begin with the Intel 80x86's native support for single- and double-precision integer arithmetic, then develop a library of variable precision arithmetic routines, and finally examine the capabilities of the 80x87 numeric coprocessor. As usual, the emphasis will be on practical rather than theoretical issues, although I will try to provide some of the more abstract references.

### BASIC TERMINOLOGY

There are two pairs of terms that will crop up repeatedly in these discussions of computer arithmetic: single-precision versus double-precision integers, and signed versus unsigned integers. We should agree on the meaning of these terms at the outset.

The maximum size of a single-precision integer varies from machine to machine, but I shall take it always to denote a number that will fit into a general register and that can be operated on conveniently

■ **Handling arithmetic operations in assembly language requires a lot of care and attention to logic; here are some proven routines to add to your programming library to make it easier.**

with single machine instructions. It is also a power-of-2 multiple of bytes. On the 8086, 8088, 80286, and the 80386 running in real mode or in 16-bit protected mode, a single-precision integer is 16 bits, or 2 bytes. On the 80386 in 32-bit protected mode, a single-precision integer is 32 bits, or 4 bytes.

As you'd expect, a double-precision integer is twice the size of a single-precision number for a given machine, and again, it is always a power-of-2 multiple of bytes. On the 8086, 8088, 80286, and 80386, in real mode or 16-bit protected mode, a double-precision integer is 32 bits. On the 80386 in 32-bit protected mode, a double-precision integer is 64 bits. Most double-precision integer operations enjoy only primitive support in the 80x86 instruction set, and—in the absence of a numeric coprocessor—must be carried out with sequences of machine instructions that are sometimes rather lengthy.

The distinction between signed and unsigned integers is straightforward. In a signed integer, the most significant bit is reserved for the arithmetic sign. The bit is

0 if the number is positive, 1 if the number is negative. The remaining bits indicate the number's magnitude. The range for a 16-bit signed integer, for example, is from -32,768 (FFFFH) to 32,767 (7FFFH). In an unsigned integer, all bits, including the significant bit, indicate magnitude. A 16-bit unsigned integer can range from 0 to 65,535 (FFFFH).

But wait a minute, you may say—that unsigned 65,535 looks just like a signed -32,768! You're quite right: bits are bits, and the "signedness" or "unsignedness" of a given bit pattern depends strictly on your point of view. But picking the right point of view is very important; a logical error in which a signed integer is treated as unsigned or vice versa can be the cause of quite subtle and difficult program bugs, as we shall see later.

**SINGLE-PRECISION INTEGER ARITHMETIC**  
The 80x86 CPU family supports single-precision integer addition, subtraction, multiplication, and division with the following instructions:

ADD	single-precision addition
SUB	single-precision subtraction
MUL	Unsigned single-precision multiplication
IMUL	Signed single-precision multiplication
DIV	Unsigned single-precision division
DDIV	Signed single-precision division

## Power Programming

The instructions listed above are your fundamental tools for working with the family of single-precision integers, and you must be thoroughly familiar with their behavior, as well as any of their idiosyncrasies. These related, but less important, instructions are

```
NEG Two's complement (multiply
    by -1)
CMP Compare single-precision
    integers
CBW Sign-extend 8-bits to 16-bits
```

ADD, SUB, NEG, and CMP set the CPU's flags (sign, carry, overflow, and zero are the most important) according to the result of the operation. Actually, CMP can be thought of as a sort of nondestructive SUB that doesn't do anything but set the CPU flags (this is an easy way to remember the order of CMP's operands).

You probably noted that ADD, SUB, and CMP do not come in "signed" and "unsigned" varieties. This is because the "signed" or "unsigned" nature of the result is solely in the eye of the beholder. If you want to regard the result as unsigned, you test the carry flag; if you prefer to think of the result as signed, you test the sign and overflow flags. The 80x86 family has an astonishingly diverse battery of conditional jumps to provide for this and similar contingencies.

For example, if you're performing a conditional branch after comparing two addresses (which are unsigned values), you would use the JB, JBE, JA, or JAE instructions. After comparing two dollar amounts (signed values), you would use the JL, JLE, JG, or JGE instructions. Testing the wrong flags or selecting the wrong type of conditional jump is a common cause of obscure program bugs—particularly when addresses are being calculated or compared. Such bugs may lie dormant for a long time and then bite suddenly when a change is made to a completely unrelated part of the program.

The multiply and divide instructions are a little more interesting and a little less regular. MUL and IMUL affect only the carry and overflow flags, leaving the rest undefined; DIV and IDIV leave the state of all flags undefined. The signed instructions—IMUL and IDIV—have slightly less range because they render special

treatment to the sign bit. Obviously, the unsigned instructions—MUL and DIV—should always be used when you are working with addresses.

Earlier, I asserted glibly that the multi-

ply and divide instructions are single-precision arithmetic operations. The whole truth is not so simple. The multiply instructions accept two single-precision operands, but they produce a double-prec-

DMUL ASM		COMPLETE LISTING	
title	DMUL.ASM Double Precision Unsigned Multiply		
page	55,132		
<pre> ; DMUL.ASM Double Precision Unsigned Multiply ; for 8086, 8088, 80286, and ; 80386 in real mode/16-bit protected mode ; Copyright (C) 1989 Ziff Communications Co. ; PC Magazine - Ray Duncan ; ; Cell with:  DX:AX = double-precision argument 1 ;            CX:BX = double-precision argument 2 ; ; Returns:   DX:CX:BX:AX = quad-precision product ; ; Destroys:  nothing         </pre>			
__TEXT	segment word public 'CODE'		
w0	equ word ptr [bp-2]		; local variables
w1	equ word ptr [bp-4]		
w2	equ word ptr [bp-6]		
w3	equ word ptr [bp-8]		
	assume cs: __TEXT		
dmul	public dmul		
	proc near		
	push si		; save registers
	push di		
	push bp		; set up stack frame
	mov bp, sp		; for forming result
	sub sp, 8		
	mov di, dx		; save copy of argument 1
	mov si, cx		
	mul bx		; arg1 low * arg2 low
	mov w0, ax		
	mov w1, dx		
	mov ax, di		; arg1 high * arg2 high
	mul cx		
	mov w2, ax		
	mov w3, dx		
	mov ax, di		; arg1 high * arg2 low
	mul bx		
	add w1, ax		; accumulate result
	adc w2, dx		
	adc w3, 8		
	mov ax, si		; arg1 low * arg2 high
	mul cx		
	add w1, ax		; accumulate result
	adc w2, dx		
	adc w3, 8		
	pop dx		; load quad-precision result
	pop cx		
	pop bx		
	pop ax		
	pop bp		; restore registers
	pop di		
	pop si		; and exit
	ret		
dmul	endp		
__TEXT	andb		
	end		

Figure 1: Here is a double-precision assembly language multiplication routine for the 8086, 8088, 80286, and 80386. It accepts two 32-bit arguments and returns a 64-bit result.

## Power Programming

sion result. One argument must always be in register AX, while the other can be in any other register or in memory; the result always appears in registers DX and AX, with the most significant part in DX. The conventional notation for this latter situation is DX:AX. (On the 80386 in 32-bit protected mode, EAX and EDX are used instead of AX and DX.)

The divide instructions accept a double-precision dividend and a single-precision divisor, and they produce a single-precision quotient and remainder. The dividend is always taken from DX:AX; the divisor can be in any other register or in memory. The quotient is always left in register AX, while the remainder appears in DX. (Again, on the 80386 in 32-bit protected mode, EAX and EDX are used instead of AX and DX.)

Why this mixing of single and double-precision arguments and results, and why this special treatment of DX and AX? The reason is that you need to be able to use the multiply and divide instructions to scale a single-precision value (by multiplying, then dividing) through a double-precision intermediate without losing any precision. Use of dedicated registers to provide arguments or to accept results is an explicit trade-off of instruction set orthogonality for more compact opcodes and therefore smaller programs.

As an aside, it is interesting to note the claims by Apple (and Motorola) that the 68000 in the original Macintosh is a 32-bit microprocessor. In spite of the fact that the 68000 has 32-bit registers, its multiply instruction works on 16-bit arguments to generate 32-bit results, and its divide instruction returns 16-bit results. This alone is sufficient to reveal the 68000 as what it is: a 16-bit microprocessor that happens to have a lot of address lines! Only in the 68020 and 68030 (used in the Mac SE/30 and various Mac II models) do we find the true 32- by 32-bit multiply and 64- by 32-bit divide that are diagnostic of a true 32-bit processor.

The 80286 and 80386 support an odd—but handy—form of the IMUL instruction that is not found on the 8086 and 8088. It is one of the very few instructions in the entire 80x86 family that has three operands: the destination is always a register; one of the source operands is a register or memory address; and the other is an "immedi-

ate" or literal value. This form of IMUL has a number of other peculiarities; the result of the operation is a single-precision value rather than double; the result can go to a register other than AX and DX; a reg-

ister argument need not be in AX or DX; and one of the arguments is not (necessarily) destroyed by the operation. For example, to multiply the contents of CX by 10 and leave the result in register BX, you


DMUL386.ASM		COMPLETE LISTING
title	DMUL386.ASM Double Precision Unsigned Multiply	
page	55,132	
.386		
; DMUL386.ASM Double Precision Unsigned Multiply		
; for 80386 32-bit protected mode		
; Copyright (C) 1989 Ziff Communications Co.		
; PC Magazine - Ray Duncan		
;		
Call with:	EDX:EAX = double-precision argument 1	
	ECX:EBX = double-precision argument 2	
;		
Returns:	EDX:ECX:EBX:EAX = quad-precision product	
;		
Destroys:	nothing	
_TEXT segment dword public use32 'CODE'		
w0	equ dword ptr [ebp-4] ; local variables	
w1	equ dword ptr [ebp-8]	
w2	equ dword ptr [ebp-12]	
w3	equ dword ptr [ebp-16]	
assume cs:_TEXT		
public	dmul	
proc	near	
; save registers		
push	esi	
push	edi	
push	ebp	
mov	ebp,esp	
sub	esp,16	
; save copy of argument 1		
mov	edi,edx	
mov	esi,eax	
; arg1 low * arg2 low		
mul	ebx	
mov	w0,eax	
mov	w1,edx	
; arg1 high * arg2 high		
mov	eax,edi	
mul	ecx	
mov	w2,eax	
mov	w3,edx	
; arg1 high * arg2 low		
mul	ebx	
add	w1,eax	
adc	w2,edx	
adc	w3,0	
; arg1 low * arg2 high		
mov	eax,esi	
mul	ecx	
add	w1,eax	
adc	w2,edx	
adc	w3,0	
; load quad-precision result		
pop	edx	
pop	ecx	
pop	ebx	
pop	eax	
; restore registers		
pop	ebp	
pop	edi	
pop	esi	
ret		
; end exit		
dmul	endp	
_TEXT	ends	
end		

Figure 2: This double-precision multiplication routine is for the 80386 CPU in 32-bit protected mode. It accepts two 64-bit arguments and returns a 128-bit result.

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ADDCORP01 11/89



## Power Programming

would write

```
IMUL BX,CX,10
```

I should mention that MUL, IMUL, DIV, and IDIV additionally support "half-precision" operations (operating on or returning 8-bit values). These are rarely used in the course of normal application programming and will not be referred to further in these columns.

### DOUBLE-PRECISION INTEGERS

The 80x86 family's support for double-precision operations is discouragingly meager. In addition to the arithmetic instructions we've already considered, you are provided with only the following:

```
ADD single-precision
      addition with carry
SBB single-precision subtraction
      with carry (borrow)
```

These instructions, in essence, allow you to propagate the carry bit through the piecewise addition and subtraction of multiple-precision values. For example, to add a double-precision value in DX:AX to a double-precision value in SI:DI, leaving the result in DX:AX, you would write

```
ADD AX,DI ; lower half
ADC DX,SI ; upper half
```

Similarly, to subtract a double-precision value in SI:DI from a double-precision value in DX:AX, leaving the result in DX:AX, you would write

```
SUB AX,DI ; lower half
SBB DX,SI ; upper half
```

Other loosely related instructions, useful mainly for conversion of single-precision values to double-precision, are

```
CWD Sign-extend 16-bits to
      32-bits
CDQ Sign-extend 32-bits to
      64-bits (80386 only)
MOVSX Sign-extend 8-bits or
      16-bits to 16-bits or
      32-bits (80386 only)
MOVZX Zero-extend 8-bits or
      16-bits to 16-bits or
      32-bits (80386 only)
```

To take the two's complement of a double-precision number, you can use the time-tested technique of flipping all the bits and then adding 1. For example, to change the sign of a double-precision number in DX:AX, you would write

```
NOT DX
NOT AX
ADD AX,1
ADC DX,0
```

A slightly faster technique relies on the fact that NEG sets the carry flag:

```
NEG DX
NEG AX
SBB DX,0
```

What about double-precision multiplication and division? Taking the single-precision native MUL, IMUL, DIV, and IDIV instructions as our guide, we know


DDIV.ASM	COMPLETE LISTING
<pre> title DDIV.ASM Double Precision Unsigned Divide page 55,132  ; DDIV.ASM Double Precision Unsigned Divide ; for 8086, 8088, 80286, and ; 80386 in real mode/16-bit protected mode  Copyright (C) 1989 Ziff Communications Co. PC Magazine * Ray Duncan  ; Call with: DX:DX:BX:AX = quad-precision dividend ;              SI:DI = double-precision divisor  ; Returns: DX:AX = double-precision quotient ;           CX:BX = double-precision remainder  ; Destroys: SI, DI  _TEXT segment word public 'CODE'  assume cs:_TEXT  public ddiv proc near  push bp mov bp,cx mov cx,32 clic  ddiv1: rcl ax,1       rcl bx,1       rcl bp,1       rcl dx,1       jnc ddiv3 ; jump if bit was clear  ddiv2: sub bp,di       sbb dx,si       stc       loop ddiv1       jnp ddiv5  ddiv3: cmp dx,si       jc ddiv4       jne ddiv2 ; yes, subtract divisor       cmp bp,di       jnc ddiv2 ; yes, subtract divisor  ddiv4: clic       loop ddiv1 ddiv5: rcl ax,1       rcl bx,1       mov cx,bp       xchg dx,bx       xchg cx,bx ; put quotient in DX:AX                   ; put remainder in CX:BX        pop bp       ret       ; restore register       ; and exit  ddiv endp _TEXT ends  and</pre>	

Figure 3: Corresponding to Figure 1, this double-precision division routine is for the 8086, 8088, 80286, and 80386 (real or 16-bit protected mode). It accepts a 64-bit dividend and 32-bit divisor, returning a 32-bit quotient and 32-bit remainder.

## Power Programming

that a truly useful double-precision multiply must process two double-precision arguments to produce a quad-precision result. Similarly, a fully generalized double-precision divide must accept a quad-precision dividend and double-precision divisor, yielding a double-precision quotient and remainder.

At this point, your intuition as a veteran 80x86 programmer is probably whispering that you are about to run short of registers. The problems actually go far deeper than

and shift-and-subtract (for division) algorithms that go back to the dawn of computer history. We'll then use these algorithms as the basis of multiple-precision multiplication and division routines capable of processing arguments of any size. In the meantime—just to tide you over and give you some code to look at—Figures 1, 2, 3, and 4 contain the source code for double-precision multiplication and division subroutines that are somewhat faster (because

they are less general). The calling sequences and results are documented in the listings.

### THE IN-BOX

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**Knuth describes an algorithm for a multiple-precision divide that is constructed on single-precision divides, but it's quite complex and not very fast.**


this, however. You might reasonably hope that the built-in single-precision multiply and divide instructions could be employed as useful building blocks for double-precision (or multiple-precision) multiply and divide routines. Unfortunately, fate is not so kind.

The hard reality is that the hardware's single-precision multiply instruction is only marginally helpful when used for stepwise multiple-precision multiplication operations in the "obvious" manner. That's because MUL and IMUL are quite slow on the older 8086 and 8088 processors. As for multiple-precision divides, the hardware's built-in divide instruction is (for all practical purposes) useless. Although Donald Knuth has described an algorithm for a multiple-precision divide that is constructed on single-precision divides, it is quite complex and—worse yet—not really very fast.

In the next installment I'll discuss the hoary shift-and-add (for multiplication)

DDIV386.ASM

COMPLETE LISTING



title	DDIV386.ASM Double Precision Unsigned Divide	
page	55,132	
.386		

```
; DDIV386.ASM Double Precision Unsigned Divide
; for 80386 32-bit protected mode
; Copyright (C) 1989 Riff Davis Communications
; PC Magazine - Ray Duncan
;
; Call with: EDI:EDI:EDI:EAX = quad-precision dividend
;           ESI:EDI = double-precision divisor
;
; Returns: EDI:EAX = double-precision quotient
;          ECX:EBX = double-precision remainder
;
; Destroys: ESI, EDI

_TEXT segment dword public use32 'CODE'
    assume cs:_TEXT
    public ddiv
    proc near
        push ebp
        mov ebp,ecx
        mov ecx,64
        cld
; save register
; ESP = 32w of dividend
; initialize loop counter
; carry flag initially clear

        ddiv1: rcl eax,1
        rcl ebx,1
        rcl ebp,1
        rcl ecx,1
        jnc ddiv3
; test this bit of dividend
; jump if bit was clear

        ddiv2: sub ebp,edi
        sbb esi,esi
; subtract divisor from dividend
; force carry flag set and
; shift it into forming quotient

        jmp ddiv5

        ddiv3: cmp ecx,esi
        jc ddiv4
        jne ddiv2
; dividend > divisor?
; no, jump
; yes, subtract divisor

        cmp ebp,edi
        jnc ddiv2
; yes, subtract divisor

        ddiv4: cld
        loop ddiv1
; force carry flag clear and
; shift it into forming quotient

        ddiv5: rcl eax,1
        rcl ebx,1
; bring least bit into quotient

        mov ecx,ebp
        xchg ecx,ebx
; put quotient in EDI:EAX
; put remainder in ECX:EBX

        pop ebp
        ret
; restore register
; end exit

    ddiv endp
    _TEXT ends
end
```

Figure 4: This double-precision division routine for the 80386 in 32-bit protected mode accepts a 128-bit dividend and 64-bit divisor and returns a 64-bit quotient and 64-bit remainder.

**D B 2**

**D B M S**

**S Q L / D S**

**I M S I D M S / R**

**R d b S Q L S I**

**S Y B A S E d B A S E :**

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CIRCLE 24 ON READER SERVICE CARD

by  
Neil J. Rubenking

# User-to-User

## TESTING COMMAND-LINE ARGUMENTS

When you use command-line arguments in a batch file, it is sometimes difficult to interpret them, because in string comparisons DOS distinguishes between lowercase and uppercase letters. Since you can't depend on users to type lower- or uppercase letters consistently, both must be checked. If the length of an argument is one character, two lines are needed. If the length is two, there must be four lines to check all alternatives (ON, On, oN, on, for example), and with a length of three there will be eight lines for checking. Thus, your batch file can become crowded with lines that almost duplicate each other. For example:

```
IF '%1'=='ONE' GOTO one
IF '%1'=='ONE' GOTO one
IF '%1'=='ONE' GOTO one
.
.
IF '%1'=='one' GOTO one
IF '%1'=='one' GOTO one
```

To identify letters regardless of case, you can use the DOS command IF EXIST. You don't tell DOS to compare %1 to a letter or number. Instead, you tell it to check for a filename that contains %1. Figure 1 shows the IF EXIST test being made on the name of the batch file RSPATH.BAT.

I use RSPATH.BAT to temporarily add a new path. With the command-line letters A, S, or R (Append, Start, and Reset), each of which appears in the filename, you can tell the batch file what kind of action you want. For instance, if you type

```
RSPATH S c:\DOS
```

a new path is added to the beginning of the old path. The A parameter appends a new directory to the end of the path string.

This batch file uses the environment variable op to save the old path first. By typing RSPATH R you can restore the old path from op. Only the last path string is saved,

■ **TESTING COMMAND-LINE ARGUMENTS:**  
Here's a new approach to validating command-line arguments for batch files.

■ **HELP FOR PROGRAMMERS:**  
This simple batch file will compile programs in any language.

■ **MANAGING MEMORY:**  
Here's the best way to unload TSRs in DOS 4.0.

so if you add several new paths, the R switch restores the path to what it was before the latest addition. If you type RSPATH R first, the variable op does not have any value and the path is not changed.

### RSPATH.BAT COMPLETE LISTING

```
echo off
rem rspath.bat
if "%1"=="*" goto error
if exist %1\%1path.bat goto reset
if "%2"=="*" goto error
if exist %1\%2path.bat goto append
if exist %1\%3path.bat goto start
goto error
:append
set op=%path%
path=%path%;%2
goto end
:reset
set op=%path%
path=%2;%path%
goto end
:start
path=%1op%
goto end
:error
echo USAGE: RSPATH A/S/R [PATH]
echo A TO ADD A PATH AT END
echo S TO ADD A PATH AT BEGINNING
echo R TO RESTORE OLD PATH
:and
path
```

Figure 1: This batch file uses the letters in its own name to test the validity of command-line arguments.

If you have not defined any path yet, you can use only the S argument, because A will set the PATH to :pathname, which is understood by DOS as NO PATH.

You will be able to use RSPATH.BAT from any directory if you put it in a directory on your original PATH. However, you must type its full pathname (including drive letter and directory) in the line that makes the IF EXIST test. DOS versions earlier than 3.0 can't make an IF EXIST comparison to anywhere but the current directory.

You also can use IF EXIST to compare filenames that usually are found in the same directory. For example, you can use C:\COMMAND.COM to test for COM (C:\%1MAND.COM), or C:\AUTOEXEC.BAT to test for EXE (C:\AUTO%1C.BAT).

If you want to use arguments not found in any existing filenames, you can make up a suitable file. For example, create C:\DELCOPY.DIR and test as follows:

```
DEL --- C:\%1COPY.DIR
COPY -- C:\DEL%1.DIR
DIR --- C:\DELCOPY.%1
```

This way you can choose arguments freely. With some consideration, you can have many letter combinations in one filename—they can even be inside one another. However, by making an extra file, you will lose one cluster of disk space.

This method is not foolproof. If you type RSPATH K and there is a file in a directory called KSPATH.BAT, the batch file will act the same as if you had typed RSPATH R. You can minimize the possibility of error by placing the file RSPATH.BAT in the root directory, or in some other directory where filenames are seldom changed.

Peeka Mattila  
Järvenpää, Finland



There are some disadvantages to this method. For example, the IF EXISTS test requires disk access and, as mentioned, there may be errors, depending on what other files are present on-disk. But it is a clever way to get around

## User-to-User

the upper/lowercase distinction.

This method is not without its problems either. As noted above, a similarly named file might cause a "false positive." To get around this, give the files an odd extension, say, \$5n, where *n* is a letter that's different for each template filename. Second, make the template files zero-length—that way they occupy only a directory entry, not an entire cluster. To create a zero-length file, the easiest method is to enter

```
REM > filename.ext
```

at the DOS prompt. Store these template files in your batch directory.

Now suppose you want to create a batch file to handle backups, with a choice of full or incremental backup. You want to allow command-line parameters of *f*, *i*, *full*, or *inc*, regardless of case. Create the template file FULL\_INC.S5A. To test for parameters use

```
IF EXIST \BAT\%1_INC.S5A GOTO Full
IF EXIST \BAT\%1ULL_INC.S5A GOTO
Full
IF EXIST \BAT\FULL_%1.S5A GOTO Inc
IF EXIST \BAT\FULL_INC.S5A GOTO
Inc
```

What if there are more parameters than will fit in a single filename? For example, up, down, left, right? Just create as many template names as needed, all with the same identifying final letter. In this case, RIGHT\_UP.S5B and LEFTDOWN.S5B would work.

Batch files are intrinsically inefficient compared with compiled programs. Using this method for identifying command-line parameters means trading the inefficiency of a huge number of comparisons with the inefficiency of maintaining template filenames. It's up to you to choose which method you prefer.

### HELP FOR PROGRAMMERS

I program in several different languages. Rather than creating a separate batch file for each compiler, I wrote COMPILE.BAT, shown in Figure 2. The syntax for using it is

```
COMPILE basefilename [compiler
options]
```

For example, to compile a program called

#### COMPILE.BAT

```
ECHO off
CD \LANGS\SRC
FOR %%e IN (ASM BAS PAS SCR) DO IF EXIST %1.%%e GOTO %%e
ECHO Source module "%1" not found
GOTO end
:asm
MASM %2 %1 C:\LANGS\OBJ\%1 %1
GOTO end
:bas
BC %1 C:\LANGS\OBJ\%1 /ZI/O/E/X%2
GOTO end
:pas
TPC %1 %2
GOTO end
:scr
CD \LANGS\PGM
DEBUG < C:\LANGS\SRC\%1.SCR
:rend
CD \
```

#### COMPLETE LISTING



Figure 2: This batch file chooses a compiler based on the source file's extension.

MYPROG.BAS, enter COMPILE MYPROG. The batch file will automatically select the appropriate compiler—in this case BC (the QuickBASIC compiler).

COMPILE.BAT first switches to the directory in which I store all my source files. The statement

```
FOR %%e IN (ASM BAS PAS SCR) DO IF
EXIST %1.%%e GOTO %%e
```

searches the directory for a file with one of the extensions included in the list. If one is

#### COMPILE.BAT

recognizes four  
types of source  
modules: Macro

Assembler,  
QuickBASIC, Turbo  
Pascal, and  
DEBUG scripts.

found, the GOTO command branches to invoke the appropriate language processor. Before ending, COMPILE.BAT changes to the root directory. If no file with the specified extension is found, COMPILE.BAT issues an error message.

As written, COMPILE.BAT recognizes four types of source modules: Macro Assembler (\*.ASM), QuickBASIC (\*.BAS),

Turbo Pascal (\*.PAS), and DEBUG scripts (\*.SCR). Other languages can easily be added or substituted by changing the values in the FOR statement.

COMPILE.BAT assumes that all source files will be in the same subdirectory. If you use separate directories for each language, remove the CD command and replace the FOR statement with separate IF EXIST statements.

COMPILE.BAT also assumes that two source files will not have the same base filename. If, for example, you have both MYPROG.BAS and MYPROG.ASM, COMPILE.BAT will choose the first file found.

Marc D. Reibstein  
Blackwood, New Jersey



Some compilers have an editor built in—you write your programs and compile them in an integrated environment. This tip won't be too useful if you generally use integrated compilers. However, many compilers *do* act on files created by an external editor, and the integrated types often include a companion command-line compiler.

You might consider adding the LINK step right into the batch file for those compilers that require it. For example, follow the MASM line with

```
IF ERRORLEVEL 1 GOTO END
LINK %1
```

The IF ERRORLEVEL test skips the LINK step if the MASM procedure fails.

### MANAGING MEMORY

You can automatically load terminate-and-stay-resident programs (TSRs) by putting the appropriate statements in your AUTOEXEC.BAT file, and you can often re-

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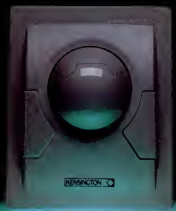
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## User-to-User

cover the memory space they use by removing them with a special command. However, you can't recover the space if you've loaded other resident programs afterward. Usually you can avoid such problems by unloading TSRs in the reverse order you loaded them.

Unfortunately, a problem can occur if you use the new DOS 4.0. When you start the graphical shell, it installs a small resident portion in memory. Therefore, if you start the graphical shell after loading TSRs, you cannot remove them and recover the space. The answer is simple. Load the resident portion of the graphical shell before loading your TSRs. Here's how:

In the subdirectory that contains your DOS routines, say DOS4, create a file named LOADSHELL.BAT. It will consist of the line

```
@ECHO & hi
```

Then, place the lines

```
CD\DOS4
SHELLS LOADSHELL
```

into your AUTOEXEC.BAT file before the lines that load TSRs. This command will not start up the DOS4 shell; it will simply install the resident portion of the shell. Now your TSRs will be loaded last and you can readily remove them from memory.

Alan R. Miller  
Socorro, New Mexico

**PC** DOS 4's graphical shell loads the SHELLB program into memory just once. After that, subsequent calls simply communicate with the copy in memory. Judging from the error message embedded at the start of SHELLB.COM, the program should fail if you don't provide a valid batch file name on the command line. However, in experimenting with SHELLB, I found that *anything* on the command line would allow it to load. Don't depend on this, though, as revisions of DOS 4.0 may correct the oversight.

DOS 4.0 provides a new program, MEM.EXE, to report on available memory. Before MEM, you had to wait through a complete CHKDSK or use a separate utility to get that information. But MEM does much more when you invoke it with the /PROGRAM command-line parameter.



Figure 3: The MEM command, new in DOS 4.0, can display a map of your system's memory control blocks when invoked with the /PROGRAM command-line parameter.

ter. MEM /PROGRAM provides a complete map of your system's Memory Control Blocks, such as the one in Figure 3.

This figure shows just what happens when you load a TSR, load SHELLB, and then unload the TSR. There are two large blocks of free RAM available to IBMDOS, one at the end of the list and one just before SHELLB. But the "largest executable program size" figure includes only the final free block plus the size of MEM itself. The other block, trapped before SHELLB, isn't accessible for large programs. If SHELLB had been loaded first,

DOS would have about 84K more RAM available.

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# Languages

## TURBO PASCAL ENUMERATED TYPES

Using enumerated types in your Turbo Pascal code can make the code much clearer and easier to understand. There is a downside to using this kind of type, however. If at some point you change either the first or last identifiers in your type definition, you have to change any code that depends on knowing what those identifiers are.

The most common occurrence of this is a FOR loop that runs from the first enumerated item to the last. Most remedies require the declaration of constants after the type declaration, to signify the First and Last identifiers. Unfortunately, the constants need to be changed any time you change the enumerated type.

Beginning with TP 5.0, you can use the `SizeOf()` function in constant expressions. This allows the compiler to create the First and Last constants dynamically; that is, when you change the enumerated type, the ordinal values of the First and Last constants are recalculated automatically by the compiler. The program shown in Figure 1

■ **TURBO PASCAL  
ENUMERATED TYPES:**  
Avoid the trouble that  
redefining Turbo Pascal  
enumerated types  
can cause.

■ **USING OUR COURIERS  
UTILITY:** Here's a look at  
the functions this serial  
port driver provides.

■ **OBTAIN EXACT TIME-OF-  
DAY MEASUREMENTS:**  
Use the method shown  
here to get the time of day  
without approximations  
or floating-point division.

demonstrates how this is done.

Enumerated types are really lists of unique identifier names. Since computers can work only with numbers, Turbo Pascal

implements enumerated types by assigning consecutive byte values to them, starting at 0. The byte values assigned to the identifiers are called their ordinal values. For example, let's say the enumerated type `Fruit` consists of (Apple, Orange, Grape, Pineapple). Their respective ordinal values are 0, 1, 2, and 3. You can easily verify this by using Turbo Pascal's `Ord()` function to show the ordinal values. `Ord(Apple)`, for example, will return 0.

Since the ordinal value given to the first identifier of any enumerated type is always zero, the constant declaration is easy. Simply typecast 0 as a `Fruit`, as follows:

```
FirstFruit = Fruit(0);
```

Finding the ordinal value of the `LastFruit` identifier is a bit more difficult—it requires the definition of an `Array` type. Using `[Fruit]` as the index type in the `FruitRay` array declaration creates an array with 1 byte for each of the identifiers in the `Fruit` type. The expression `SizeOf(FruitRay)-1` gives the ordinal value of the last fruit, in this case the value 3.

The size of the `FruitRay` array depends on the `Fruit` Type declaration. Adding or removing identifiers in that declaration results in a larger or smaller array size. The last identifier in the enumerated type is defined by the following expression:

```
LastFruit = Fruit(  
  sizeof(FruitRay)-1 );
```

To test the method, add and remove identifiers from the `Fruit` Type declaration in the program in Figure 1 and rerun the program.

Don Stenczewik  
Rochester, New York



If you declare all of your enumerated types in this way and use the first and last constants as needed, you'll avoid the possibility of breaking a program by changing the identifiers in the enumerated type. You don't increase the size of the compiled program by adding

### ENUMLAST.PAS

### COMPLETE LISTING

```
PROGRAM Enumerated;  
(* Insert more items in the enumerated type "Fruit". The  
   program will still correctly display the ordinal values  
   of all the items. *)  
TYPE  
  Fruit = (Apple, Orange, Grape, Pineapple);  
  FruitRay = array[Fruit] of byte;  
  
CONST  
  FirstFruit = Fruit(0);  
  LastFruit = Fruit(sizeof(FruitRay)-1);  
  
PROCEDURE ShowAllFruits;  
VAR  
  F : Fruit;  
BEGIN  
  WriteLn('Here are the ordinal values of all the fruits:');  
  For F := FirstFruit To LastFruit DO  
    Write( Ord(F):3 );  
  WriteLn;  
END;  
  
BEGIN  
  ShowAllFruits;  
END.
```

Figure 1: Changing the members of an enumerated type can break your programs, but not if you follow the method illustrated in this program.

## Languages

the "extra" source code—the array type doesn't take any space, and the calculation to set the values of the first and last constants takes place at compile time.

The ordinal value of the first identifier in any enumerated type is always 0, but it would be handy for Turbo Pascal to provide a built-in last function. The information does exist, even in a compiled program—the range-checking code uses it. But your program doesn't have access to that data. Hence the need for workarounds like the one Mr. Stenczewik provides.

However, if you are devious, you can get at the upper and lower limits for any scalar type. When your program performs a range check, it calls a routine that sets ES:DI to point at an 8-byte area containing two LongInts. The first is the lower limit, and the second is the upper limit. Immediately after a range-check call, ES:DI still points to this block. The `INLINE` functions shown in Figure 2 use this information to get the two limits. You do need to use them

in a very specific way, though.

First, assign any variable of the type in question to itself (for example, "A:=A;") with range checking ON. Then, immediately afterward, set a LongInt variable to either "first" or "last".

These functions work in Versions 4, 5, and 5.5 of Turbo Pascal. Of course, they're not actually necessary, and they may not work in later versions. But they do serve to extract information that the compiler doesn't normally provide.—Neil J. Rubenking

### USING OUR COURIERS UTILITY

In this issue we present 1STCLASS, a utility that was designed to help you manage your MCI mail as well as send and receive ASCII and binary files. It requires the services of COURIERS, a memory-resident serial port driver that has a set of function calls 1STCLASS uses to replace the inefficient routines that are available through the BIOS.

COURIERS is also a standalone utility and can be used with other programs requiring a serial port driver. To understand how you can take advantage of COURI-

ERS' serial services in your programs, let's examine its functions.

The general format follows that of BIOS calls. The caller places a function code in AH; a COM-port number (1 to 4) in AL; and parameters as necessary in the AX, BX, and CX registers, and then executes an INT 14h instruction. COURIERS

**1STCLASS is a  
utility designed  
to help you manage  
your MCI mail.**

returns result codes in AX.

**Function 80h:** Check if COURIERS is loaded. If COURIERS is loaded, it returns 232 (decimal) in AH; otherwise, the BIOS returns some indeterminable value. Any program using COURIERS should start by verifying that COURIERS is loaded and asking the user to load it if it isn't—just as 1STCLASS does. (AL is ignored in this case.)

**Function 81h:** Check if port is busy. COURIERS returns a code in AH: 2 means that the port does not exist; 1 means that the port exists and another program is using it; 0 means that the port is available.

COURIERS reports code 1 only if another program is using the port via COURIERS' own services. There would be no way to check with any confidence if another program were using a port in some other way. 1STCLASS skips this nicety and seizes the port it is told to use.

**Function 82h:** Configure a port. Before doing any I/O, a program should configure the port with this function. The line speed in bits per second is passed in BX, and CX contains a bit vector of various options. Only the low 2 bits are currently assigned: Bit 0001h tells COURIERS to handle input flow control; Bit 0002h tells COURIERS to handle output flow control.

Input flow control means that COURIERS will send Control-S's and Control-Q's to regulate the flow of incoming characters. Output flow control means that COURIERS will regulate its character transmission according to Control-S's and Control-Q's that it receives.

In addition, bit 0004h is reserved for requesting COURIERS to operate the line



Figure 2: This program uses a routine that is called when range checking is done. This routine sets ES:DI to point to an 8-byte location containing two LongInts that handily correspond to the upper and lower limits of your enumerated type.



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under the X.PC protocol. This is not yet implemented.

When configuring the port, COURIERS sets it to send and receive 8-bit characters with 1 stop bit and no parity. There are currently no alternatives.

**Function 83h:** Start input. This function provides COURIERS with the specifications of an area of memory that COURIERS can use as a circular buffer for incoming characters. ES:BX points to the buffer and CX contains its length in bytes. If input flow control is requested, then the buffer should be at least 128 bytes. The largest allowable buffer is 65,536 bytes, the size of a memory segment. The address provided for the buffer must be such that every byte in it can be addressed using the segment provided in ES. COURIERS does not check for this, however, and if provided, say, with a buffer address of 1F1D:F000 and a size of 40,000, it would fail rather horribly.

After input is initiated with this function, it continues until the port is deconfig-

ured (function 8D). It is very important that a program deconfigure a port after using it or else COURIERS could be left stuffing stray characters into an area of memory being used by another program for some completely different purpose.

**COURIERS is a stand-alone utility and can be used with other programs requiring a serial port driver.**

And that could lead to serious bugs.

**Function 84h:** Read a character. This function requests that COURIERS extract the next character from its input buffer and return it to the program. On returning, COURIERS sets the ZF processor flag to indicate whether or not input was available. ZF = 1 means that no input was

available. If ZF = 0, then COURIERS also returns a character in AL along with a copy of the status bits read from the COM port in the AH register.

Note that there is no facility for making COURIERS wait for incoming data. If a program just wants to spin its wheels until a character shows up, it should invoke this function in a loop until the ZF flag is returned as zero.

In most cases, it is safe to ignore the status bits. The only one that might possibly have meaning is the status bit that denotes a framing error on the received character. Note, however, that COURIERS adds 1 status bit of its own, the highest or sign bit, to indicate an input buffer overflow. If input flow control is turned on and operating correctly and the buffer is sufficiently large, an overflow should never occur.

**Function 85h:** Flush pending input. COURIERS discards any characters waiting to be read from its input buffer.

**Function 86h:** Start output. COURIERS initiates the transmission of a sequence of characters. ES:BX points to the data and CX contains the byte count. COURIERS returns to the calling program once the transmission is under way; it does



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## Languages

not wait until transmission is complete.

The same caveats about buffer addressing given for the input function 84h apply equally here.

**Function 87h:** Output status. COURIER returns the number of characters awaiting transmission in AX. It is safe to initiate another transmission only when the returned value is zero. The ZF flag is also set to indicate whether AX is zero or not. To wait for completion of a transmission, a program should call function 86 and then repeatedly call 87 until a zero value is returned.

**Function 88h:** Abort output. COURIER terminates any transmission in progress.

**Function 89h:** Transmit a single character. COURIER transmits the character passed in CL. This function may be called repeatedly with no tests or checks between calls. It would typically be used by a program such as a terminal emulator.

**Function 8Ah:** Send BREAK. COURIER transmits a BREAK condition for approximately 385 milliseconds. Note that COURIER does not detect receipt of a BREAK.

**Function 8Bh:** (Not used.)

**Function 8Ch:** Set speed. COURIER resets the speed of the port. The caller provides this speed in BX. ISTCLASS uses this function to change speeds when a connection is completed at a speed other than that for which the modem was primed.

**Function 8Dh:** Deconfigure port. COURIER stops input on the port and

turns off all interrupts. As discussed above, it is very important that a program invoke this function upon completing use of a COM port.—Pete Maclean

### OBTAIN EXACT TIME-OF-DAY MEASUREMENTS

I would like to call attention to a widely used but inaccurate procedure for converting the BIOS clock count to the time of day. It is common practice to use the high word of

The PC's timer  
crystal oscillates  
at a frequency of  
1,193,180 Hz, or  
slightly more than  
a million ticks  
per second.

the 32-bit counter returned in CX:DX by interrupt 1Ah, function 0, as the number of hours that have passed since midnight. Unfortunately, this method does not provide an exact measure of time.

The PC's timer crystal oscillates at a frequency of 1,193,180 Hz, or slightly more than a million ticks per second. Every 65,536 cycles, a time-of-day interrupt is generated; this updates a counter in the BIOS data area. On average, the counter is

updated 18,265 times per second, which works out to 65,543 updates per hour. Since 65,543 is very close to 65,536 (the capacity of a 16-bit word), it turns out that the high word of the BIOS counter is updated roughly once every hour.

The routine shown in Figure 3 illustrates a procedure for converting the BIOS clock count to seconds without resorting to approximations or floating-point division. It calls interrupt 1Ah, function 0, to get the clock count and returns the number of seconds that have passed since midnight in CX:DX. It effectively multiplies the BIOS clock count by 65,536, then divides it by 1,193,180. To avoid using numbers greater than 32 bits in length, it breaks the division into two steps, first dividing by 59,659, then by 20.

Charles Hannum  
Henryville, Pennsylvania

**PC** I confess—I'm one of those who have used the approximate method in the past. When you just need a quick estimate of the current time, it's really not that bad. The worst you can do is end up overestimating the amount of time that has passed since midnight by a few seconds.

Still, it's not entirely accurate, and we expect computers to be perfect, don't we? The method you've outlined works and, as you noted, it avoids having to multiply and divide large integers. Doing so is always a pain on any Intel processor other than the 386, which has the capacity to deal with 64-bit quantities.

Mr. Hannum's routine employs a clever work-around. The multiply-and-divide process is broken into four discrete steps, each of which is handled with 32-bit quantities. Incorporate this as a subroutine into your own programs and you can forget about the BIOS's cryptic clock count and deal with the more-straightforward units we all think in terms of: seconds.—Jeff Prossie

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#### CLOCK TICK CONVERSION ROUTINE

```
begin: xor     ah,ah      ; Call interrupt 1Ah,  
int      1Ah           ; function 0  
  
mov     ax,dx          ; Move count from CX:DX to  
mov     dx,cx          ; DX:AX  
mov     bx,59659       ; Divide by 59,659  
div     bx  
  
mov     cx,ax          ; Save quotient  
xor     ax,ax          ; Divide remainder (shifted  
div     bx             ; left 16 bits) by 59,659  
  
xchg    ax,cx          ; Divide original quotient  
xor     dx,dx          ; by 20  
mov     bx,20  
div     bx  
  
xchg    ax,cx          ; Divide remaining portion  
div     bx             ; by 20  
mov     dx,ax
```

Figure 3: Use this assembly language routine to accurately convert clock ticks to seconds. The method shown here provides an accurate time-of-day measurement.



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edited by  
Tony Rizzo

# Tutor

## OUTPUT VERSUS DISPLAY

What is the relationship between the screen resolution of a displayed image and the resolution of hard copy obtained from the program that generated the image? More specifically, would I get better printed images from an 8514/A or a super VGA than I would from a standard VGA?

Roger E. Webb  
Bressler, Pennsylvania



With most application software, there is no relationship between the resolution of the display and the resolution of printed or plotted output. In *AutoCAD*, for example, a drawing printed on a dot matrix printer looks the same whether you're running it on a CGA, a VGA, or a 1,024-by-768 video card such as IBM's 8514/A. The reason is that an *AutoCAD* image is stored in memory as a series of descriptors that define the positions and attributes of graphic entities such as lines, curves, arcs, and text, with a resolution that is many times higher than what either the screen or hard-copy device can produce. To project the image to the screen, *AutoCAD* uses a display driver that translates the virtual image into one compatible with the video subsystem. To print the image, a printer or plotter driver is used. The only link between the two is that both derive their output from the same in-memory model.

The trend in the graphics industry is toward device independence, in which the same program can run on a number of different hardware platforms with little or no change to the program. OS/2's Presentation Manager offers a measure of device-independence to programs that run under its auspices through the graphics programming interface. Device drivers supplied with Presentation Manager are capable of handling a variety of different displays and printers. Rather than having to create dozens of different drivers to support the wide range of hardware options available on the PC (witness the number of printer drivers packaged with *WordPerfect*), OS/2 pro-

■ **OUTPUT VERSUS DISPLAY:** The quality of your printer—not your screen—determines the quality of your output.

■ **HOW BUS SPEED AFFECTS A PC'S PERFORMANCE:** A bus only has to be fast enough to keep up with its peripherals.

■ **PROCESSING THE F11 AND F12 FUNCTION KEYS:** Here's a way to tell if your BIOS supports extended keyboard services.

■ **A BUG IN THE EARLY IBM VIDEO BIOS:** The BP register isn't saved during some function calls, despite documentation claims.

■ **READING HARD DISKS:** How manufacturers ensure disk readability despite varying data densities.

grammers can devote their resources to developing application programs. Device handling is left to the operating system.

The exceptions to this rule are programs that print graphics from the bitmap displayed on the screen. The DOS GRAPHICS.COM utility, for example, pulls the data it sends to the printer directly from the video buffer. As a result, the better the video adapter, the better the hard-copy output. Few modern application programs use this technique, simply because the printed images they produce look crude in comparison to graphics printed by programs

that exploit the full resolution of the hard-copy device. In addition, it is extremely difficult to output bitmapped images to plotters. Plotters think in terms of vectors rather than pixels—an important distinction to high-function graphics programs that use plotters rather than printers for the highest-quality hard-copy output.—Jeff Prosser

## HOW BUS SPEED AFFECTS A PC'S PERFORMANCE

It's common to run the I/O bus of a fast 386 machine at a clock speed lower than that of the CPU. The Compaq Deskpro 386/25, for example, pairs a 25-MHz CPU with an 8.33-MHz bus. How does bus speed affect the performance of a PC?

Son Pham  
Englewood, Colorado



The higher the bus speed, the faster the peripherals connected to the bus can transfer data to and from the CPU. If the bus is fast enough to keep up with the external devices attached to it—hard disks, serial ports, and expansion-card RAM, for example—then any additional speed is irrelevant: system throughput is limited by the peripherals. If the bus is slower, however, it becomes a bottleneck in the system that effectively inhibits performance by throttling data-transfer rates.

Let's look at specifics. For most devices, an 8.33-MHz bus speed is more than adequate to keep the CPU from becoming bound by the bus. For example, a typical data-transfer rate for a fast ESDI drive controller is around 5 megabits per second. A 16-bit bus running at 8.33 MHz requires 120 nanoseconds to complete one clock cycle. Paired with a 286 or 386 microprocessor, which requires two clock cycles to access a 16-bit unit of data on the bus, that bus can deliver data at rates exceeding 8Mb per second. The same bus with a 32-bit design can transfer more than 16Mb per second, far more than the drive controller itself could ever hope to deliver.

## Tutor

In this case, it doesn't make any difference whether the bus is running at 8.33 MHz or 25 MHz. The data-transfer rate from the hard disk is limited by the drive controller, not by the bus.

One variable that you can't factor out of the performance equation is the width of the bus in bits. A 16-bit bus can transfer twice as much data in a given time period as an 8-bit bus. In turn, a 32-bit bus offers twice the bandwidth of a 16-bit bus if the clock speeds are the same, and four times the bandwidth of an 8-bit design.

The one device that can consistently outpace the bus is RAM. Even the slowest RAM chips used in 386 systems, which typically have access times in the neighborhood of 100 nanoseconds, can divulge bytes faster than most buses can handle them. As a result, it's to your advantage to install as much RAM as possible on the system board of a 386 PC, since the path from there to the CPU will in all likelihood be 32 bits wide, and to install auxiliary memory boards in 32-bit slots. Most 386 machines provide at least one 32-bit slot for added memory. The penalty for installing RAM in a slow I/O channel is wait states—clock cycles spent waiting for data when the CPU could be doing other things.

—Jeff Prossie

### PROCESSING THE F11 AND F12 FUNCTION KEYS

How does an application program process the F11 and F12 function keys? Do F11 and F12 generate extended keyboard codes like the other function keys?

Louis Schuetz  
Arvada, Colorado



Function keys F11 and F12 generate extended key codes that can be trapped by calling interrupt 16h, function 10h. Function 10h, the keyboard BIOS extended keyboard read service, works just like function 0—the normal keyboard read service routine—except that it supports a number of keys and key combinations that weren't supported in IBM's original keyboard BIOS.

On return from the interrupt, the AL register will be set to 0 and AH to 85h if F11 was pressed. F12 produces a 0 in AL accompanied by the value 86h in AH. If your program traps key presses with interrupt 16h, function 0, presses of F11 and F12 will not register. It will be just as if no key had been pressed.

To determine whether or not the BIOS supports this and other extended keyboard services, design your program so that it follows the procedure outlined in Figure 1. First, interrupt 16h, function 5, is called to attempt to write the value FFFFh hex to the keyboard buffer. If, on return, AL is set to FFh, then the extended functions are not supported. If it returns any other value, then the extended functions are supported. Function 10h must then be called to clear the FFFFh entry from the keyboard buffer.—Jeff Prossie

### A BUG IN THE EARLY IBM VIDEO BIOS

I recently encountered a strange anomaly while testing a set of MASM routines written for C. One of the routines calls interrupt 10h, function 6, to clear the screen. This worked fine on my PC clone, but it locked up a genuine IBM PC. A little work with DE-BUG showed that the IBM PC's video BIOS altered the BP register during processing of the interrupt 10h function call, destroying the C program's stack-frame pointer. Yet

the BIOS documentation claims that all registers that do not return values are preserved. What gives?

Jonathan Wood  
Tustin, California



You've run across a well-known bug in some of the early versions of the IBM PC video BIOS. The BIOS fails to save the BP register but uses it in functions 6 and 7 to store a value that is two times the number of columns displayed on the screen—the byte offset between identical locations on succeeding lines.

Functions 6 and 7 aren't the only ones that use BP indiscriminately. Function 8, which reads characters and attributes from the video buffer, allocates a temporary storage area for itself on the caller's stack and uses BP as a stack-frame reference when the PC is in graphics mode. The solution is to save BP on the stack before calling any routine from the video BIOS. In fact, pushing BP onto the stack should be the first action every C subfunction takes. Almost all C compilers require that the value of BP be preserved across function calls.

Saving BP is a must if your assembly language routine needs to access parameters passed on the stack or requires local storage space on the stack, because only BP can be used in base-plus-displacement addressing relative to segment register SS. Even if no parameters are passed or local storage isn't needed, saving BP ensures that someone else's improper use of the register won't cause your program to crash.

You can make a strong argument that the misuse of BP by the BIOS is not a bug at all, but rather a documented quirk. A note in IBM's assembly language listing for the BIOS dated October 27, 1982, warns that only CS, SS, DS, ES, BX, CX, and DX are preserved during interrupt 10h processing and that other registers may be destroyed—clearly indicating that it's up to the caller to save BP. However, the first edition of the *IBM Personal System/2 and Personal Computer BIOS Interface Technical Reference*, dated April 1987, erroneously states that the BIOS interrupt handlers "save all registers except AX, the flags, and those registers that return a value to the caller." Don't believe it. If you call interrupt 10h functions from a program where BP must be preserved, save it first. An ounce of prevention is worth a pound of cure.—Jeff Prossie

#### HOW TO TEST FOR EXTENDED BIOS KEYBOARD SUPPORT

```
begin: mov cx,0FFFFh    ;Attempt to write key code
        mov ah,5        ;To keyboard buffer with
        int 16h         ;function 5
        cmp al,0FFh     ;if AL = FF on return,
        je not_supported ;extended keyboard BIOS
                     ;is not supported

        mov ah,10h      ;Clear the keyboard buffer
        int 16h         ;before proceeding
        .
        .
        .
```

Figure 1: A program can test for extended BIOS keyboard support using this assembler code. If function 5 succeeds in writing a character to the keyboard buffer, extended keyboard functions are supported. A return value in AL of FFh indicates that extended functions are not supported. If the call succeeds, function 10h should be called to clear the entry from the keyboard buffer.



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# Tutor

## READING HARD DISKS

One of the parameters set by the drive type specification on AT hard disks is write precompensation. What is it, and what are the consequences of setting it to a value that is either too high or too low?

Robert J. Sandler  
New Milford, New Jersey



The sectors located on the innermost cylinders of a hard disk are physically smaller than those on the outside. To ensure that what's written to the surface of the disk in this region can be read back without error, the signal must be specially conditioned to compensate for the greater data density. This process is known as *write precompensation*. The write precompensation value encoded into a hard disk's parameter table is the cylinder where write precompensation begins.

This value is normally determined by the drive manufacturer based on experimental and statistical data, but it is not a hard and fast number. Entering a slightly lower value than the manufacturer recommends—effectively enabling write precompensation nearer the outside edge—will have little effect on drive performance. Entering a write precompensation value *much* lower than recommended can result in false signals being read from the drive surface. Setting write precompensation higher can produce soft errors when the drive heads attempt to read data from a cylinder where write precompensation should have been used but wasn't.

As long as you choose the correct drive type when you install a new hard disk into your system (assuming that your PC supports the same drive type numbering system that your hard disk's drive type designation is based on), you can be assured that write precompensation will be set correctly.—Jeff Prossie

## ASK THE TUTOR

The Tutor solves practical problems and explains points of general interest about using your hardware and software more productively. To have your questions answered here, write to Tutor, *PC Magazine*, One Park Avenue, New York, NY 10016, or upload them to PC MagNet (see the "By Modem" sidebar in the Utilities column). We're sorry, but we cannot answer questions personally. ■





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To all those unlucky enough to be stuck smack in the middle of the current spreadsheet confusion, take heart.

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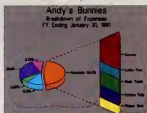
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Frank J. Derfler, Jr.

# Connectivity Clinic

## SPEED NETWORK INSTALLATION


I've gotten a lot out of your Connectivity Clinic and would like to pass on a hint for configuring Novell's Entry Level Systems (ELS) NetWare.

There are two ways to install ELS. If you have drives that are already certified, you can simply run the INSTALL program. However, if you have new drives that need to be certified, you must run the STARTUP program. But this can take over an hour for a 60MB drive.

With *Advanced NetWare*, you can sidestep the COMPSURF part of the installation procedure by using *Disk Manager-N* from Ontrack Computer Systems. Unfortunately, you can't use *Disk Manager-N* to speed up ELS installation, because it doesn't install Novell's Hot Fix.

We finally came up with a procedure that speeds installation enormously. You certify the drives with Ontrack's software, run NETGEN to install the Hot Fix software (this takes only a minute or two), then quit NETGEN and run the INSTALL program supplied with the ELS Level 1. I hope this hint saves as much time for others as it has for us.

Barry S. Oxenhandler  
St. Louis, Missouri

 We use Ontrack's *Disk Manager-N* in the LAN Labs all the time, because it cuts a lot of time off the two or three *NetWare* installations we do every week. *Disk Manager-N* has a retail price of \$249.95. Contact Ontrack at (800) 752-1333 for more information.

## BIOS-DRIVER INCOMPATIBILITIES

We've run into a really strange problem and hope you can suggest a solution. We wanted to use an ALR computer as a node on a Novell network. To do this, we installed the G/Ethernet AT card from Gateway Communications that you recommended in your Ethernet card review in the January 31, 1989, issue. This card gave us a good connection to the server, but DOS couldn't find

■ **SPEED NETWORK INSTALLATION: A tip for configuring ELS NetWare.**

■ **BIOS-DRIVER INCOMPATIBILITIES: Some combinations of DOS, ROM, and LAN drivers just don't work.**


■ **MCI ON A LAN: Two methods for getting MCI Mail service over a network.**

the local drives in the ALR.

We replaced it with a Western Digital 8003 Ethernet card and generated a new workstation shell for *NetWare* on the ALR. We had a good connection to the server, and DOS found the local drives. However, it couldn't find any files on the server!

Finally, we took a 3Com 3C503 card and the IPX.COM and NET3.COM files from another machine and installed them on the ALR. Everything worked fine! What was happening?

John Thomas  
Herndon, Virginia

 Call ALR and get an updated ROM BIOS! The driver software for each of the cards you tried was written using different techniques. The drivers were certified by Novell, but not with every computer vendor's version of ROM BIOS. There are apparently enough incompatibilities between the drivers and the BIOS to prevent them from working together all the time. Many of these companies update their products often, so if you ever have problems interfacing with otherwise "standard" products, ask for the latest copy of the software.


While the problem sounds like driver-BIOS incompatibility, there is one other

thing you might check. Since each of the cards you mentioned uses a different memory location to read and write to the system memory, it is also possible that you are having memory conflicts.

## MCI ON A LAN

We used *Lotus Express* in our office to send and receive MCI Mail. But now that we've installed a network, we don't have enough RAM to load it. *Lotus* apparently doesn't intend to provide a network version. Our LAN software came with a pretty good e-mail package, but it has no links to MCI Mail. Any hints about how we can get MCI Mail service on our LAN?

Bill Jergens  
Chicago, Illinois

 You have two alternatives for getting good MCI Mail service over a PC-based network. Both methods involve dedicating one computer as an MCI Mail server.

First, you can buy an e-mail package for your LAN that includes an MCI Mail gateway. One caveat: many have promised, but few have delivered a good MCI Mail gateway. The best gateways, such as the one that is an option to Da Vinci Systems' *eMAIL*, use the Message Handling Service (MHS) utilities sold for \$100 by Action Technologies ((415) 654-4444) and provided free by Novell with *NetWare*. However, you might have to rearrange all of the MCI Mail accounts in your organization, because the gateway packages we have seen generally use a single group EMS account. This is an administrative matter you can take up with MCI.

We experimented with another method of setting up an MCI Mail gateway. It can handle only nine private user accounts, but it is effective. In the *PC Magazine* LAN Labs, we set up one PC-XT as a node on the network and loaded it with *Lotus Express* configured for our MCI Mail accounts. We then load either *R2LAN* from Crosstalk Communications or *Close-*



## Connectivity Clinic

*Up!LAN* from Norton-Lambert. Both of these programs work like their more familiar RS-232C remote-control relatives, but they do their work across a network instead of across phone lines. Either package lets us remotely control the MCI Mail machine across the network.

With either of these LAN remote control products installed, any node on the network can, on a one-at-a-time basis, operate the MCI Mail gateway machine to check on, reply to, or create mail.

Since *Express* operates in background mode, users can get on and off the MCI Mail gateway machine quickly and let *Express* handle things on its own. They can use the *Express* File commands in order to

save incoming mail on the XT.

A word of warning: because of a software interrupt conflict between *NetWare*'s IPX and the X.PC protocol used in *Express*, *Express* will not save files on the network drive over a *NetWare* LAN. This is fine for mail, but it requires a lot of work-arounds if you want to use attached files.

Setting up the *Lotus Express* "server" took patience, because we had to remap keys and carefully manage the memory, but it does work.

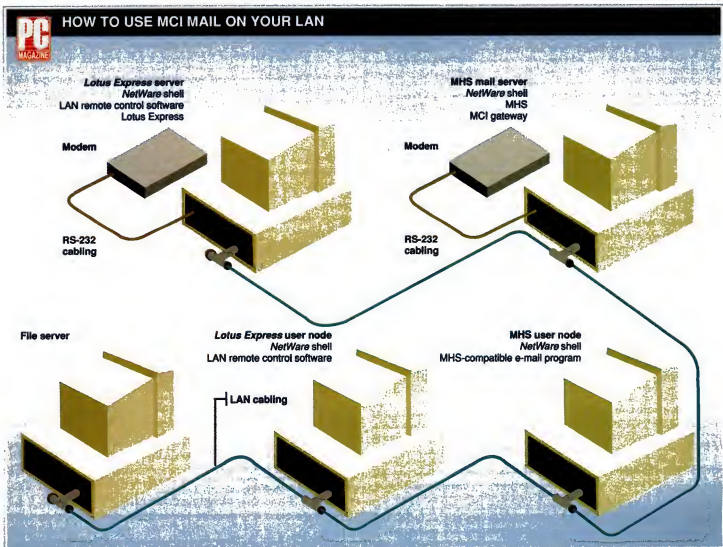
Figure 1 illustrates how a LAN could be set up with an MHS server for MCI Mail and a station running *Lotus Express* that can be remotely controlled across the network.

If you are interested in software providing remote control across the LAN, investigate the two new competing products in

the market: *Close-Up!LAN* from Norton-Lambert ((805) 964-6767) and *R2LAN* from Crosstalk Communications ((404) 998-3998).

### NETWORK YOUR QUESTIONS

Connectivity Clinic gives you practical solutions to networking problems of all types. We'll pay \$50 or more for any tips we print, plus an extra \$25 if you submit your letter on a disk. If you do, please include a printed copy. We'll gladly answer your questions at no charge, but we cannot answer letters personally. Mail contributions to Connectivity Clinic, *PC Magazine*, One Park Avenue, New York, NY 10016, or upload them to PC MagNet (see the "By Modem" sidebar in the Utilities column). You may also contact Frank J. Derfler, Jr., via MCI Mail (use Derfler's box named CONNECTIVITY CLINIC). ■



**Figure 1:** This LAN has both a server using Action Technology's Message Handling Service (MHS) utilities for MCI mail and a station running *Lotus Express* that can be remotely controlled across the network. The diagram shows the software modules loaded into the gateway and user nodes. The MHS client station runs an e-mail package, like Da Vinci Systems' eMAIL, with an interface to MHS. The *Lotus Express* client station uses a LAN remote control product like *Close-Up!LAN* or *R2LAN* to run *Express* on the *Lotus Express* "server."

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TurboSport 386-40	CALL

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<b>TOSHIBA T5100/40MB with DESIGNER Carry Case</b>	3799
<b>PANAFAX UF-135</b>	575
<b>PANASONIC KXP-1124 w/stand</b>	315

<b>MONITORS</b>	
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If you experience a problem with anything you purchase from CompuAdd, call 800-666-1872, weekdays from 9:00am to 7:00pm, CST. Our technical support staff will be happy to assist you with any hardware or software difficulty. If we cannot resolve a hardware problem over the phone, we will arrange you a return national authorized service (NARS). We ship the equipment, freight and customer prepaid to our Austin Service Center. We will repair or replace the product at no cost to you without cost to you and pay for the return freight. You may also carry the product into one of our North American Supercenters where our repair staff can assist you on the premises. Call 800-666-1872 for a copy of CompuAdd's complete warranty.

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40MB	64702	64707	64712
60MB	64703	64708	64713
80MB	64704	64709	64714

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- 0 wait state page-mode memory
- Built-in dual IDE hard drive interface
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- Built-in parallel port and two serial ports
- Built-in game port interface
- Three full-size 16-bit and two half-size 8-bit expansion slots
- 80287 math coprocessor support
- Choice of 5.25" 1.2MB or 3.5" 1.44MB diskette drive
- Real-time clock
- 101-key enhanced keyboard
- 145-watt power supply

Monitor optional.

## The CompuAdd 810

*Perfect for word processing, spreadsheet and database applications, the 810 is also an economical alternative for LAN stations that don't need 80286 or 80386 architecture.*

### An unbeatable value offering:

- NEC V20® processor rated at 10MHz
- 640KB RAM with parity checking
- Built-in dual IDE hard drive interface
- Built-in dual diskette drive controller
- Built-in parallel port and two serial ports
- Built-in game port interface
- Three full-size and two half-size PC XT™ expansion slots
- 8087 math coprocessor support
- 5.25" 360KB diskette drive
- Optional real time clock
- 101-key enhanced keyboard
- 145-watt power supply

Monitor optional.



**\$895**  
64730

#### 212 Monitor and Hard Drive Options

	MGA	EGA	CVGA
20MB	64731	64736	64741
40MB	64732	64737	64742
60MB	64733	64738	64743
80MB	64734	64739	64744

## The CompuAdd 216

*Our new 216 meets the speed and power needs of OS/2™ and SCO™ XENIX®.*

- All of the same features as the CompuAdd 212 with a blazing processing speed of 16MHz.

Monitor optional.



**\$995**  
64715

#### 216 Monitor and Hard Drive Options

	MGA	EGA	CVGA
20MB	64716	64721	64726
40MB	64717	64722	64727
60MB	64718	64723	64728
80MB	64719	64724	64729

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## The CompuAdd 316s

Power packed on a small footprint, the 316s opens the door to 386 software at an exceptionally low price. Like all 300 series systems, the 316s comes with one year of **FREE** onsite service.

- 80386SX processor running at 16MHz
- 1MB memory expandable to 4MB on motherboard
- 0 wait state page-mode memory
- Built-in dual IDE hard drive interface
- Built-in dual diskette drive controller
- Built-in parallel port and two serial ports
- Built-in game port interface
- Three full-size 16-bit and two half-size 8-bit expansion slots
- 80287SX math coprocessor support
- Choice of 5.25" 1.2MB or 3.5" 1.44MB diskette drive
- Real-time clock
- 101-key enhanced keyboard
- 145-watt power supply

Monitor optional.



**\$1495**  
64787

### 316s Monitor and Hard Drive Options

	MGA	BGA	CVGA
40MB (20min)	\$64785	\$64963	\$64792
80MB (15min)	\$69999	\$69449	\$68330
100MB (15min)	\$67169	\$64344	\$64794
120MB (15min)	\$63339	\$60779	\$62780
140MB (15min)	\$64790	\$64065	\$64796
160MB (15min)	\$65229	\$62679	\$63960

## The CompuAdd 220

"If what you want is a fire-breathing DOS machine, the CompuAdd (220) is a good choice." *PC Magazine* (4/11/89)

- 80286 processor running at 20MHz
- 1MB RAM expandable to 5MB on motherboard
- 0 wait state page-mode memory
- Disk caching software
- LIM 4.0 support
- ROM shadowing into faster DRAM
- Dual IDE hard drive interface
- Dual diskette drive controller
- Built-in parallel port and two serial ports
- Six available expansion slots
- 80287 math coprocessor support
- 40MB IDE hard drive
- Monochrome VGA monitor
- 16-bit VGA video adapter card
- Choice of 5.25" 1.2MB or 3.5" 1.44MB diskette drive
- 101-key enhanced keyboard
- INTEGRATOR™ software



**\$2449**  
64799

### 220 Monitor and Hard Drive Options

	MVGA	CVGA
40MB (15min)	\$47759	\$48052
80MB (15min)	\$50449	\$50809
100MB (15min)	\$48000	\$48306
120MB (15min)	\$48079	\$48399
140MB (15min)	\$48079	\$48399
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At the heart of the new Career Starter Kit is our most affordable XT-compatible workhorse, the new CompuAdd 810, with its sleek, small footprint design. Surrounding the 810 is a package that contains everything you need to start computing. Monitor. Printer. Cables. Operating and applications software. Even paper and blank diskettes.

**\$899**  
64716

- CompuAdd 810 computer (XT-compatible)
- NEC V20 processor rated at 10MHz
- 500KB RAM with parity checking
- Built-in dual IDE hard drive and game port interfaces
- Built-in dual diskette drive controller
- Built-in parallel printer port and two serial ports
- Three full-size and two half-size PC XT expansion slots
- 5.25" 360KB diskette drive
- 8027 math coprocessor support
- Monographics monitor and adapter
- Star™ Micronics NX1000™ printer and cable
- 101-key enhanced keyboard
- CompuAdd MS-DOS (v4.01) and GW BASIC™ software
- New Spinnaker™ Eight-in-One™ integrated software
- Computer paper and ten blank diskettes

### Career Starter Kit Options

	MGA	CGA	CVGA
No Hard Drive	\$64716	\$64771	\$64786
20MB	\$6999	\$6939	\$6839
40MB	\$64717	\$64722	\$64727
60MB	\$64718	\$64723	\$64728
80MB	\$64719	\$64724	\$64729

Color monitor optional.

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Looking for the value, savings and convenience of a package purchase? Unwilling to sacrifice quality, flexibility, reliability or technical support when you invest in a business computer? Look no further.

**Computerize Your Business for \$1495**  
64747

- CompuAdd 212 computer (AT compatible) with 40MB hard drive
- 80286 processor running at 10MHz
- 512KB RAM expandable to 4MB on motherboard
- 0 wait state page-mode memory
- Choice of 5.25" 1.2MB or 3.5" 1.44MB diskette drive
- Built-in dual IDE hard drive and game port interfaces
- Built-in dual diskette drive controller
- Built-in parallel printer port and two serial ports
- Three full-size 16-bit and two half-size 8-bit expansion slots
- 80287 math coprocessor support
- Monographics monitor and adapter
- Panasonic™ 1180 printer and cable
- 101-key enhanced keyboard
- CompuAdd MS-DOS (v4.01) and GW BASIC™ software
- CompuAdd INTEGRATOR productivity software
- Real-time clock
- Computer paper and ten blank diskettes

### Professional Starter Kit Options

	MGA	BGA	CVGA
40MB	\$64747	\$64752	\$64757
60MB	\$64748	\$64753	\$64758
80MB	\$64749	\$64754	\$64759

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screen and .31mm dot pitch provides 640x350 resolution. #1210 **\$349**  
**Mitsubishi Diamond Scan EGA color monitor 14" (13" viewable)** screen and .31mm dot pitch provides 640x350 resolution. #1207 **\$535**  
**NEC MultiSync 2A Super VGA color analog monitor 14" (13" viewable)** screen and .31mm dot pitch provides 800x600 resolution. #1208 **\$510**  
**Seiko Instruments 14" monitor** flat, black Trinitron™ screen with up to 1024x768 resolution, .26mm dot pitch, and one electron gun technology for intense colors. #1002 **\$595**

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Okidata Microline<sup>®</sup> 320 (11" carriage, 300 draft/30 NLQ). 56339 **\$339**

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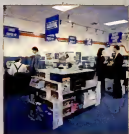
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**TakeTwo**  
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ST157N	3.5"	49MB	40 msec	<b>\$389</b>
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Standard Features	286-Based Computers				386-Based Computers			
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On Board Memory	1MB	1MB	1MB	640K	1MB	2MB	1MB	1MB
Possible On Board Upgrade	4MB	NONE	13MB	4MB	8MB	4MB	16MB	16MB
Floppy	1.2MB (5¼") (7%)	1.44MB (5¼") (7%)	1.44MB (5¼") (7%)	1.2MB (5¼") (7%)	1.2MB (5¼") (7%)	1.44MB (5¼") (7%)	1.44MB (5¼") (7%)	1.2MB (5¼") (7%)
Standard Hard Disk	40MB (28ms)	20MB (28ms)	20MB (28ms)	20MB (40ms)	40MB (28ms)	15MB (28ms)	40MB (28ms)	40MB (28ms)
Available Hard Disk Upgrades†	16MB (33ms)	NONE	40MB (33ms)	40MB (33ms)	33MB (33ms)	16MB (33ms)	33MB (33ms)	33MB (33ms)
Operating System Software	DOS 4.01 (\$45)	DOS 4.01 (\$125)	DOS 4.01 (\$120)	DOS 4.01 (\$119)	DOS 4.01 (\$45)	DOS 4.01 (\$125)	DOS 4.01 (\$120)	DOS 4.01 (\$119)
Price	\$1595	\$2095‡	\$1395‡	\$1699	\$1995	\$2995‡	\$2599	\$2399
Optional EGA Card/Monitor	\$395	—	—	—	\$395	—	—	—
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† Up to 330MB

‡ Without Monitor

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NX1000	167
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2400B NEC, Epson	189
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NEC MultiSpeed's	Call
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T1000 768k Card	259
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T1600	Call
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Paradox 3.0	419
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Rbase for DOS	397
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2400B Int. Modem	119
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Super VGA #5400	255
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80387-20	379
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Autoswitch 480	115
VGA Plus	175
VGA Plus 16	229
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Multisync 4d/5d	479
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Max15	237
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Ultrasync 14"	519
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<b>Sony</b>	
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<b>Zenith</b> 1490	595

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<b>Mitsubishi</b>	
60MB AT MR535	379
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40MB AT #251-1	319
65MB AT #277R-1	365
80MB AT #4096	559
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Call On Non-Listed Items

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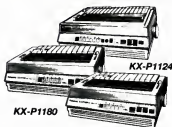
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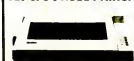
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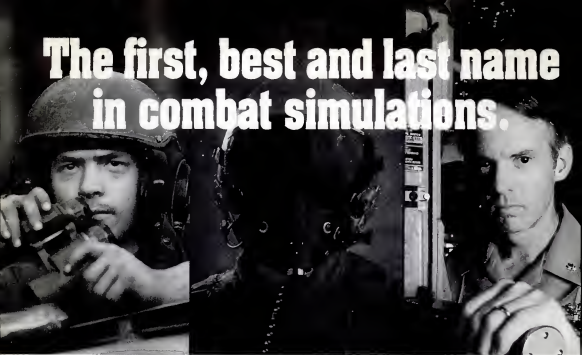
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6. Does your company own:  
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7. Do you plan to buy any PC products?  
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## ■ WORD PROCESSING HEAVYWEIGHTS

You love *WordPerfect*. You'll never switch. He loves *Microsoft Word*. He'll never switch. She's been using *DisplayWrite* for years. She'll never switch. Who's right? Contributing editor Edward Mendelson dissects the latest versions of the three market-leading word processors, *IBM DisplayWrite 5/2 Composer*, *Microsoft Word 5.0*, and *WordPerfect 5.0*, and draws some interesting conclusions. Which package best fulfills your word processing needs? Check out all the angles, from mouse control and mail-merge to desktop publishing functionality and OS/2 performance.

## ■ LOTUS 1-2-3 UPGRADES

Travel the twisting Lotus upgrade path with contributing editor M. David Stone as he explores the new territories of *1-2-3*, Release 3, and *1-2-3*, Release 2.2. Do these two versions finally offer the same functionality as other spreadsheets that have been taking bites out of Lotus's market share? Also, contributing editor Jim Seymour analyzes the current state of the spreadsheet market and offers advice on buying decisions for the near future.

## ■ DIGITIZING TABLETS

In the burgeoning realm of alternate input devices, users are looking beyond mice for help with their desktop publishing, CAD, and illustration applications. Contributing editors Winn L. Rosch and Frank Bican take an in-depth look at 24 digitizing tablets from 15 companies, including Hewlett-Packard, Houston Instrument, Kurta, Pconcept, and Summagraphics. With more manufacturers getting into the game, it's getting harder for the old-time leaders to hold their own in this competitive field. ■



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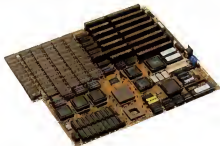
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# After Hours

Products for the Leisure Side of Personal Computing

## Bill Paying Without Tears: CheckFree Dispenses With the Paperwork

PERSONAL FINANCE  
by Mitt Jones

PC-based electronic banking is a very attractive concept. Aside from its obvious conveniences—no lines, no tellers, no paper checks to forget to mail—it has the ring of poetic justice. After untold decades of dealing with banks on their terms, we finally get to push the buttons ourselves. Alas, with a handful of exceptions, banks brave enough to take a chance on such a service have found that their depositors alone can't support such a volume-dependent venture.

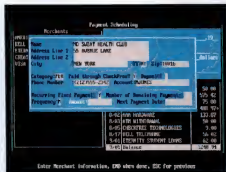
Enter CheckFree Corp. and its national CheckFree bill-paying service. No matter where you bank, CheckFree lets you pay your bills by PC and modem, drawing funds electronically from your existing checking or NOW account. Because CheckFree uses the same electronic transfer system used by banks and the Federal Reserve, your bank has no choice but to support the service, unless it cares to violate federal banking regulations.

The primary drawback of

CheckFree, at least when compared with on-line services offered by banks, is its lack of full access to your accounts. While CheckFree can draw funds electronically from your bank, it cannot

electronic banking by virtue of its on-line nature, CheckFree operates more like standalone check-writing programs such as Intuit's *Quicken*. Just as *Quicken* turns your instructions into printed checks, CheckFree turns them into electronic payment requests.

Getting up and running with CheckFree is surprisingly easy and hassle-free. The first thing you'll need is the \$49.95 startup kit, which you order directly from



This CheckFree screen accepts input for new payees. Once the information is entered, the payee is added to a merchant list for later selection.

fetch your current balance or help you transfer money from one account to another.

In fact, though related to

the company or through CompuServe (type GO CF) with a 30-day money-back trial period. In addition to *Servisware* soft-

■ **PERSONAL FINANCE**  
CheckFree brings bill paying into the 1990s.

■ **VIDEO**  
VCR Companion spices up home videos.

■ **GAMES**  
The Colony: trapped in space.

ware, the kit contains a registration form, which asks for information such as your social security number, bank name, and account number.

Within a couple of weeks after mailing out your registration, you'll get back a CheckFree account number and your local CheckFree access number. CheckFree Corp. handles the hassle of notifying your bank and billers that you'll be using the system.

For each "merchant" you'll be paying with CheckFree, you enter such information as name, address, phone number, and, if applicable, account number into the program. While CheckFree makes actual electronic fund transfers only to institutions that accept such payments, it sends a laser check to those that don't, including your landlord or Great-Aunt Bessie. Either way, the payment shows up on your bank statement, complete with amount and merchant name, so you'll have a paper record of all transactions.

You begin the payment process by picking a merchant from the merchant list. A semblance of a paper check appears on-screen, with blanks for payment date, amount, and memo. When you're ready to send the payments, you simply choose the appropriate

CONTINUES

## CheckFree Access Available Through Third-Party Software

by Mitt Jones

While CheckFree Corp. offers its own competent software as an interface to its national bill-paying service, it has also opened the service to other personal finance packages.

Intuit's *Quicken* 3.0 is the first third-party program to support the service, though its support is less seamless than one would have hoped. You must

still maintain CheckFree's *Servisware* and use it to access the CheckFree payment center. *Quicken* then allows you to update the *Quicken* check register to add the new transactions. Current copies of *Quicken* contain a *Quicken* registration form that lets you purchase the CheckFree software for only \$9.

Andrew Tobias's *Check-Write Plus* and *Managing Your*

*Money* will also offer CheckFree support, though neither had added it by the time of this writing. Unlike *Quicken*, both programs will directly and seamlessly support the CheckFree service without need for additional software or any CheckFree sign-up fee. Service charges run \$9 per month for 20 transactions and \$3 extra per additional 10 transactions.



## After Hours

### CheckFree

CONTINUED

option from the *ServiceWare* menu.

After prompting you for verification, the software automatically dials the payment center and transmits the payment information in encoded form. Upon completion of the transmission, *ServiceWare* automatically adds the payments to your check register, where you can also manually enter deposits, non-CheckFree payments, and other transactions.

Many of the advantages of CheckFree are boons of electronic banking itself. For instance, you can schedule fixed, recurring payments with the press of a few keys. Until told otherwise,

concern. While no on-line service can claim absolute protection against high-tech bandits, CheckFree seems to be reasonably secure.

That's true in part because you work out your payments with the software off-line, and then the program automatically sends the instructions to the payment center. This allows access to the payment center to be tightly patrolled. According to CheckFree Corp., the center looks for specific information in your CheckFree files each time you log on, including but not limited to your account number.

In addition, because CheckFree routes payment requests through the Federal Reserve, chances are slim that a crime-minded technophile could do much with your account without getting nabbed,

### CheckFree: One Reviewer's Experience

by Mitt Jones

To give CheckFree a thorough test, a certain brave reviewer linked the service to his checking account in early 1989.

After six months of real-life use, I can report no catastrophes or even major inconveniences. The only problem I experienced involved one payment a merchant received but failed to post on my account.

CheckFree will pay the amount at the interval you specified, without your lifting a finger.

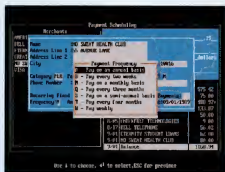
You can also schedule unfixed payments well in advance, a real advantage if you don't like bills sitting around but also don't want your money working for someone else while it could be working for you. CheckFree makes its money from service charges, not by floating your money, so the \$200 you've instructed the service to pay XYZ Credit Card on December 1 won't be withdrawn from your account until the electronic payment or laser check is posted, usually on December 1 but never before then. CheckFree service charges are \$9 per month for up to 20 transactions plus \$3 per each 10 additional transactions.

Of course, when dealing with your precious checking account, security ranks as an important

even if he managed to break through CheckFree Corp.'s security system.

Check #	Date	Desc	Amount	Posting Balance
101	7/13/91	XYZ CREDIT CARD	150.00	150.00
102	7/13/91	XYZ CREDIT CARD	150.00	300.00
103	7/13/91	XYZ CREDIT CARD	150.00	450.00
104	7/13/91	XYZ CREDIT CARD	150.00	600.00
105	7/13/91	XYZ CREDIT CARD	150.00	750.00
106	7/13/91	XYZ CREDIT CARD	150.00	900.00
107	7/13/91	XYZ CREDIT CARD	150.00	1050.00
108	7/13/91	XYZ CREDIT CARD	150.00	1200.00
109	7/13/91	XYZ CREDIT CARD	150.00	1350.00
110	7/13/91	XYZ CREDIT CARD	150.00	1500.00

CheckFree's software can keep track of payments not made through the service; you can choose from a list of expense categories.



One of the joys of electronic bill paying is the ability to schedule recurring payments at many different intervals.

Alas, nothing in this world is quite perfect, and CheckFree is no exception. While the service itself seems well conceived and well run, the *ServiceWare* software is rather outdated and limited, stressing ease of learning rather than versatility, speed, and convenience.

The full-page check register is functional and fairly easy to use, but you'll find no convenient way to browse through your past transactions. While the software includes such niceties as *Lotus 1-2-3* file export and several types of financial reports, it doesn't include a register/transaction backup function—a necessity for a program such as this. It's easy enough to add the necessary commands in a batch file, but you won't even find a

mention of how to do this in the *ServiceWare* manual.

Other shortcomings: the program limits you to one budget category per payment, one payment per merchant per transmission, and one checking or NOW account per *ServiceWare* installation.

In all fairness, if your needs are simple, you'll find the software only mildly annoying, and CheckFree Corp. has promised to solve most of the problems in upcoming releases. In the meantime, if you like the idea of the CheckFree service but don't want the limitations of its *ServiceWare* software, you're in luck: several personal finance packages now offer interfaces to the CheckFree bill-payment system (see the sidebar on the previous page).

The bottom line? Despite its few limitations, CheckFree makes bill paying a quick, painless task rather than a monthly ritual to be dreaded. If you're weary of searching your desk drawers for one last stamp or trying to recall the amount of mystery check 547, CheckFree may be just what you need.

**List Price:** CheckFree startup kit, \$49.95; startup kit plus Hayes Personal model 1200, \$149.95; usage fees: \$9 per month for first 20 transactions, \$3 per additional 10 transactions or any portion thereof. **Requires:** 256K RAM, DOS 2.1 or later, Hayes-compatible modem. CheckFree Corp., P.O. Box 897, Columbus, OH 43272-4320; (800) 882-5280.

CIRCLE 544 ON READER SERVICE CARD



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## After Hours

### VCR Companion Adds Effects To Home Video Tapes

VIDEO  
by Don Trivette

If you are one of the six million Americans with a camcorder, you may welcome Broderbund's *VCR Companion* as an inexpensive way to add a touch of class to your videos.

Using *VCR Companion's* design elements, you can create animation and titles for everything from weddings to backyard slapstick. The elements include backgrounds (for example, cake, calendar, claphboard), bor-



Broderbund's *VCR Companion* offers a variety of visual special effects to perk up your home video productions.

ders (columns, lace, rainbow), patterns (brick, confetti, zigzag), fonts (deco, neon, slime), and icons (flame, cops, robot), which can be put together in a script

that would make MGM jealous.

Once the script is complete, you connect your VCR (Beta or VHS) to your computer, push a few buttons, and a boring vacation travelogue becomes... well, a beautifully titled, boring travelogue. (*Companion* can't work miracles.)

Titles and animation are created using point-and-shoot menus

that you probably won't need to read the 50-page manual until you get ready to connect your PC and VCR.

Connecting and operating the computer and camcorder are detailed in the manual, but EGA and VGA users are out of luck; only the old Color Graphics Adapter has the composite video connection that *VCR Companion* requires. EGA and VGA users may want to use a camcorder to film the action directly off the computer screen, but the results are amateurish. And speaking of results, CGA colors and resolution leave (as always) a lot to be desired (see sidebar).

#### Limited Graphics

With only 120 graphics elements, *VCR Companion's* library is considerably smaller than *Home Video Producer*, another VCR titling program, although Broderbund does sell a supplementary graphics disk. In addition, *Companion's* icons are of a fixed size and are limited to three locations on the screen—top, middle, and bottom.

## How to Convince Your TV to Display EGA and VGA Images

by Don Trivette

At the dawn of personal computing, IBM created a color graphics standard known as CGA that was, even then, primitive in both detail and color. Only two preset colors, along with black and white, can be displayed in CGA's graphics mode. Perhaps its one virtue is that it's compatible with television; almost all CGA cards have a composite video output that can be connected to a TV or VCR.

As graphics became more important, IBM introduced the EGA and more recently the VGA graphics standards. Both of these have higher resolution and the capability to display many colors at once. But neither EGA nor VGA is compatible with the television/VCR standard called NTSC.

In order to put EGA/VGA computer graphics on a videotape (or view them on a television set), you need hardware to convert them to an NTSC signal. Several companies, including Progressive Image Technology in Folsom, California, Avocado Computer of Yorba Linda, California, Commu-

nications Specialties in Hauppauge, New York, and RGB Technology in Berkeley, California, sell converter boxes to do just that—for a price.

The high cost of converter boxes is because of both the relatively small market and the complex circuitry that reduces the resolution of the EGA/VGA output without distorting its content.

Avocado Computer sells the ART-1 videoboard, which is an NTSC encoder designed to work only with EGA systems. The half-size card takes its input from your EGA board via a short jumper cable and outputs to an EGA monitor and VCR or television. At an affordable \$250, it has no over-ly feature or other frills.

Progressive Image Technology is reading a VGA board called VideoVGA for introduction in the fall of 1989; it will have one output for a VGA monitor and another output for an NTSC video signal. The board will also have a video input jack so that you can overlay images. VideoVGA will cost about \$1,000.



Using *VCR Companion's* art elements, you can develop eye-catching title screens to save or transfer to video.

accessed with either a mouse, a joystick, or the cursor keys. A special-effects menu lets you join individual scenes by fades, fizzles, in's in/out, spirals, wipes, or checkers.

You don't even have to fire up the program to see the possibilities: Broderbund includes a full-color reference card showing all the different fonts, borders, backgrounds, and icons. The creative process is so intu-

If you aren't into making a video connection, you can use *VCR Companion* to make animated greeting cards. Put a card on a floppy disk and the recipient can then play it, without special software, on his or her own computer.

For example, the script of a video birthday card for a basketball player might open with the text "Happy Birthday," fade into

CONTINUES

## After Hours

### VCR COMPANION

CONTINUED

a picture of a cake over which walks a pair of sneakers, and then scroll into a party scene with balloons.

If you have a CGA card and will settle for the relatively low resolution, *VCR Companion* can really dress up your home video projects. And PC-based greeting cards will certainly impress your PC-equipped correspondents. But even if you never title a movie or send a video card, you can spend many pleasant hours creating filmstrips; indeed, *VCR Companion* is really a drawing program for those of us who can't draw.

**List Price:** *VCR Companion*, \$54.95. **Requires:** 256K, DOS 2.0 or later. Composite video output required for connection to a VCR. Broderbund Software Inc., 17 Paul Dr., San Rafael, CA 94903; (800) 521-8263.

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## The Colony: An Old Story Perked Up by Hot Graphics

VIDEO  
by Barry Brenesal

Just as you expected, life isn't easy for a Regional Space Marshall. Especially in Mindscape's *The Colony*. You've got to deal with the problems of policing the Outpost Segment. There are natural disasters, pirates, and occasionally nonhumanoid races that don't like bipeds without feathers.

Just now (wouldn't you know it) that last possibility has arisen. A group of settlers in Delta 5-5 has been invaded and destroyed by mysterious alien beings, whose aggressive instincts and inexplicably homicidal behavior most closely parallel those of certain TV personalities.

It would seem easier just to quietly ignore this strange race and take up something more profitable, like real estate sales.

However, they have cryogenically frozen a small group of Colony children, presumably for later study, or perhaps for between-meal snacking. And to make matters worse, the crash onto Delta 5-5 has destroyed your reactor core.

That's pretty much the starting point of *The Colony*. The plot line isn't anything new. Take away the visuals, and the game might be an early Infocom text adventure. There are mazes to navigate, clues to find, and puzzles to figure out. Even the run-ins with alien nasties aren't terribly far removed from the traditional Infocom monsters in *Zork*.

Mindscape has deliberately made its product as "unfriendly" as possible, in an effort to enhance this sense of an unfamiliar universe. Beyond the basic keyboard commands (movement, view, and so on) and a few facts about the ship, little is revealed.

What sets *The Colony* apart from most games is its innovative graphics. The shape of an object visibly changes with the angle of perspective. Although

program speed and size limitations force the use of simple wireframe outlines, there remains an unusually realistic feel to the alien landscape, and an almost palpable presence to the encounters.

*The Colony* was originally written for the Mac, and its extensive use of graphics makes heavy demands on your system. If you're using anything slower than a 286, consider switching from a color monitor to monochrome. You might also add a TSR like THEFAST or ZENO (both available as shareware) to speed up screen writes.

In sum, *The Colony* isn't an overwhelmingly original game, but it is good fun, and the graphical interface is addictive. Hopefully it is a harbinger of further developments from Mindscape along similar lines.

**List Price:** *The Colony*, \$49.95. **Requires:** 640K RAM, graphics card, hard disk, DOS 2.1 or later. Mindscape Inc., 3444 Dundee Rd., Northbrook, IL 60062; (312) 480-7667.

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by  
Bill Howard

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## Next Month: DTP Guru John Brainerd

From Fred Abatemarco's Editor's Note introducing "The Power Brokers," Personal Computing's July 1989 cover story:

"You'll meet dozens of other interesting people in 'The Power Brokers,' many for the first time, and a number who are well-known figures. Two who deserve special attention are Steve Jobs of NeXT and Paul Warnock of Adobe Systems. . . .

"Warnock's PostScript, says Editor at Large Michael Antonoff, 'is the graphics language that revolutionized printing technology.' And that's just the start of things for Adobe Systems' president and CEO, the man we call the hottest star in Silicon Valley."

Most people call the hottest star in Silicon Valley John Warnock

## Amazing Facts I

From "How to Maintain Floppy Disks," Information Center, August 1989: "Never group two or more disks together. Otherwise, 'imprinting' may occur, as information stored on one may cause an impression on the others."

## Amazing Facts II

"Laptop computers first appeared in the early 1980s and have become increasingly popular with consumers. Also known as 'mini-computers' or 'portables,' laptops perform most of the functions of the larger, personal computers. . . .

—Regina (Saskatchewan) Leader-Post,  
April 3, 1989

## Amazing Facts III

"Computer viruses are pieces of computer code that move from machine to machine, often reproducing themselves and sometimes making computers sick. . . .

—Everett (Wash.) Herald,  
March 14, 1989



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PC Magazine gives you \$50 and a PC Magazine T-shirt if we use your submission in Abort, Retry, Fail? Warning: Don't write on the original (it might be reprinted, mark up a photocopy or use a Post-it). In case of duplicate entries, the nearest entry wins. Winners this issue: Jim Seymour (Paul Warnock), Clint Laing (Excel Road), Arthur Kuehnle (3,000 volts), Michelle Brenner (OS/3), Larry E. Larska (floppy disk advice), Brian Ferguson (laptop minicomputers), John D. Bonitas (viruses)



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